Rensselaer Polytechnic Institute.

THE

Rensselaer Polytechnic Institute.

Its Reörganization in 1849–50*; Its Condition at the Present Time; Its Plans and Hopes for the Future:*

BY THE

DIRECTOR OF THE INSTITUTE.

ALSO,

THE STATEMENT OF A COMMITTEE

APPOINTED BY AND OF THE TRUSTEES OF THE INSTITUTE, FOR THE PRESENTATION OF ITS VARIOUS INTERESTS TO THE CITIZENS OF TROY.

TROY, N. Y.:
D. H. JONES & CO., PRINTERS, 216 RIVER STREET.
1855.

INTRODUCTORY NOTE.

The following explanatory sketch of the Institute and its system, has been prepared at the request of the Committee whose statement follows, with the hope that it may contribute to the diffusion of more accurate knowledge than, it is to be feared, now prevails in our own community, with respect either to the real objects of the Institute or its plans of future development. It is deemed proper to remark that the mere notice which is here introduced, of some of the more prominent Polytechnic Institutions of Europe, has seemed to be *the very least* that could be said on this point in order—as was the object of their introduction in this paper—to aid the formation of an intelligent judgment of the characteristics as well as utilities of that class of educational institutions in which the Institute finds its place.

Troy, December, 1855.

THE
Rensselaer Polytechnic Institute.

It is scarcely to be doubted that, in respect to the Rensselaer Polytechnic Institute, there is considerable misapprehension, not to say ignorance, more or less prevalent with regard to its position, objects, and other characteristics, as an educational establishment. And, yet, this is not so remarkable when it is understood as it properly should be, that some of the most material changes, in what may be called the *characteristics* of such an institution, have been effected in this within a period of less than six years past. To explain the nature of these changes, the considerations which conducted to them, the consequences which have resulted from them, and the present aims and hopes of the Institute management, will be the main objects of this paper.

Re-organization of the Institute.

Prior to the year 1850, the Rensselaer Institute was announced, and generally understood to be an institution for "Instruction in *Mathematics*, *Physics*, *Chemistry*, *Geology*, and *Natural History*, with their Applications to Civil Engineering, the Arts, Manufactures, and Agriculture." These, indeed, were substantially the objects of the institution, as originally established in 1825, by its Founder, Stephen Van Rensselaer; and, with unimportant deviations in the style of declaration or details of execution, these continued to be the declared objects of the Institute, through the intervening period of a quarter of a century, up to the date mentioned at the opening of this paragraph. At this time, the present Direction of the Institute, after an experience of nearly three years with its plans and workings, had reached the conclusion that, notwithstanding the acknowledged usefulness of the institution upon its then existing basis,

it nevertheless did, and must continue to fail to realize those better results, which, as an educational establishment, it might, and, indeed, ought to be capable of, were it not for certain radical defects in fundamental features of its organization. These were believed to be, first, in the recognition of educational objects which were not only too *comprehensive in reach*, but liable to be *too vaguely and indefinitely worked out*, to admit of that completeness of treatment or that balancing of parts, so essential to anything like satisfactory results; and, secondly, as if to render more unmitigated the evils noted under the first head, in the *short time, allowed to be sufficient*, for the preparation of candidates for the scholastic or professional degrees conferred by the Institute Board.

The Managers of the Institute, therefore, resolved, that *their field should be narrowed and more thoroughly cultivated;* that, indeed, their educational objects should be restricted to matters immediately cognate to ARCHITECTURE and ENGINEERING; that, moreover, for a somewhat irregular and for the most part optional course, requiring but a single year for its accomplishment, they would substitute a carefully considered Curriculum, which should require at the least three full years of systematic and thorough training; and that, finally, they would demand the application of the strictest examination tests to the successive parts of the course prescribed, not only in respect to the translation of students from lower to higher classes, but, especially, in all cases of ultimate graduation with professional degrees.

It was in accordance with such views as these that, in 1849–50, this institution was wholly reörganized upon the basis of a general POLYTECHNIC INSTITUTE, when it received the distinctive addition to its title, under which it has since been more or less generally known. Its objects were thenceforward declared to be "The education of ARCHITECTS and CIVIL, MINING, and TOPOGRAPHICAL ENGINEERS, upon an enlarged basis, and with a liberal development of Mental and Physical Culture." It was, however, also declared that, the educational advantages of the Institute should not be restricted to those only who might be destined to professional pursuits, but "should be made available and eminently useful to all others, whether contemplating a future professional career or not, who, appreciating and desiring such a course of educational training, would be willing to submit to the discipline required for its successful accomplishment."

But it is proper to remark that, with the comprehensive statement and formal announcement, then made, of what was proposed to be the future work of the Institute, there was associated in the minds of its Managers no immediate expectation of realizing more than a very partial development of their plans, with the comparatively limited resources in *matériel* of every

kind at their command. Accordingly, it was resolved, that, of the entire Institute Curriculum, they would at first proceed to develope the GENERAL COURSE—the common scientific basis of the four Professional Courses—and the two specialities of CIVIL and TOPOGRAPHICAL ENGINEERING, to as good a degree of excellence as should be practicable under the existing circumstances; while they would defer any attempt to effect the more complete development of their plans, including the important specialities of ARCHITECTURE and MINING ENGINEERING, to a period when they might hope to be able to invoke effectively the aid of conditions more favorable to realizations so desirable.

RESULTS OF THE RE-ORGANIZATION.

With the preceding somewhat general statement of the considerations which determined the present alterations in the Institute System, a pertinent inquiry might now be suggested, as to the results of experience in working out such a series of changes;—changes, too, so likely to be productive of important consequences, as those whose original inception has been referred to the period in question. But to answer this inquiry by a statement in detail of the actual experience of the Institute during a period of six years past, would be as tedious to the readers, as it would doubtless be inexpedient for the objects of this paper. Nevertheless, the following general comparison may serve the immediate purpose of illustrating these results as they appear from a certain point of view, and, at the same time, form a not inappropriate introduction to some more particular statements to be given hereafter:—In 1849, with a course of study which was, undeniably, somewhat vague, unsystematic, and incomplete, there was an attendance of thirty to thirty-five students; while the annual income from tuition fees—exclusive of that from other sources—did not exceed sixteen hundred dollars: At the present time, with a course of systematic, extended, and somewhat severe training, strictly wrought out, at least, in the case of every *graduate* of the Institute, there is an attendance of over one hundred students; while the annual income from tuition fees alone—now fifty per cent. higher than at the former time—amounts to more than seven thousand dollars. And, yet, while far from undervaluing the importance naturally attached to the number in attendance at an educational establishment, it may, nevertheless, fairly be questioned whether this, *in itself*, can be regarded as proof of any peculiar or remarkable excellence in such an institution; otherwise, it were necessary to admit the existence of such excellences in institutions—of not unfrequent occurrence in this country—whose basis for such a distinction it would be difficult to

find, save in a facility for gathering in hundreds of students from a surrounding country, at rates of tuition marvellously cheap.*

And, hence, we should be altogether unwilling to have the results of the Institute experience estimated by such a standard *alone*—a standard as superficial as it would be unjust. On the contrary, how *tangible* soever as indications of a vigorous and active life, we would prefer to have these results seen, when taken in connection with accompanying circumstances,—as we hope to be able to show,—to be evidence equally tangible, of the *complete and triumphant success of a most important educational experiment.*

The fact is scarcely appreciated—not, certainly, as it should be—by many citizens even in our own midst, that an institution located in a retired part of this city, occupying quarters as unimposing in exterior as they are limited in extent, enjoys a patronage—to say nothing of reputation—that, in view of all the circumstances, might well be coveted by any educational establishment in the land. We say, in view of all the circumstances; for, with buildings and surroundings less attractive than those of many a country academy,—with a comparatively high rate of tuition,—with the utter absence of all those means, so frequently resorted to, for attracting attention to an institution through the public prints;—with, in short, a display of resources so limited—of temptations so poorly contrived to allure public appreciation;—nevertheless, on a direct observation, the following facts are as conspicuous as they are significant, namely: that, from all parts of the United States,—from Upper and Lower Canada,—from the tropical regions of the West Indies and South America,—there is an annual accession of young men to the successive classes of this Institution, which, besides annually increasing, is even now quite respectable in number†; that, moreover, these are, in general, derived from those quarters in which an intelligent appreciation of the peculiar objects of the Institute would be likely to find place; and that, finally, these annual accessions comprise bodies of young men, who, for capacity, intelligence, and all those characteristics of manhood most suggestive of a promising future, are scarcely equalled, certainly not excelled by a similar collection of students at any other institution in this country.

We trust that we may be pardoned if we attach too much importance to this matter; but we are, nevertheless, constrained to believe that, in

---

*We do not, of course, refer to those institutions that, with large productive endowments, can afford to make low rates of tuition, and at the same time, exact *sound scholarly training* in the person of every recipient of their graduation honors.

† During the past year as follows: From foreign countries;—*Brazil*, 4.—*Cuba*, 5.—*Canada*, 7. From the United States;—*Me.*, 3.—*Mass.*, 9,—*Conn.*, 4.—*Vt.*, 2.—*N. J.*, 6,—*Penn.*, 9.—*Md.*, 2,—*S. C.*, 3,—*Ga.*, 2,—*La.*, 1,—*Miss.*, 2,—*Ill.*, 3,—*Ohio*, 2,—*Cal.*, 1,—*New York City*, 9,—*State at large*, 33,—*City of Troy*, 9. Total, 116.

such results as these, we have a well-grounded basis, for all we claim in the conclusion enunciated in a preceding paragraph; that, indeed, with such an experience, the Institute may fairly and logically claim to have passed beyond the doubtful issue of a mere experiment, and to have reached a present position, in which it may, without serious presumption, assume *to know the ground on which it stands.*

Its Objects those of a Polytechnic Institute.

And, now, it may be proper to repeat, or state in another form, the objects originally proposed in the reörganization of the Rensselaer Institute. These objects were, to develope the original and peculiar excellences of this institution, into a true Polytechnic Educational Establishment, on a liberal basis and with elevated aims. An institution whose characteristics of development should be suggested, partly, by its own most instructive experience of more than thirty years as a School of Theoretical and Practical Science; partly, by the published organizations, courses of study, and practical workings of the Polytechnic Institutions and Special Industrial Schools of Great Britain and, more especially, of France and Germany; and, in part, also, by the results of observation and study of the *professional wants in this country* of those classes of men, for whose benefit the institution would be more especially designed. But in order to obtain a more distinct conception of the present objects of the Institute, and then be able to form an intelligent judgment of the importance which is here claimed for them, it will be necessary or, at least, highly serviceable, to take a brief preliminary survey of the plans and workings of that class of educational institutions of the old world, in which our institution finds its place.

SCIENTIFIC AND TECHNICAL INSTITUTIONS IN EUROPE.

The establishment of Polytechnic Institutions for educational purposes is in manifest obedience to a demand of the most general interest of the present age.

In all civilized countries, the prosecution of industrial pursuits, in some one of their multiform phases, constitutes the prime business of man.—Whether we regard his operations as an Agricultural Producer,—as a Manufacturer or Artisan,—as a Merchant or Factor,—or, finally, as an Engineer or Architect, adapting his works to the wants common or peculiar of all the rest,—still, how different soever the respective modes, they nevertheless concur in contributing to the advancement of the great business of life—PRODUCTIVE INDUSTRY.

But a new era for industry has been commenced during the present century. Science has cast its illuminating rays on every process of Industrial Art. The discoveries and improvements which have so frequently flashed into view, have indeed, attested, in a manner the most striking, the mutual advantage to Science and Art—to theory and practice—of a better mutual acquaintance. That there has been a large gain to both, as well of mutual enlightenment as of mutual rectification, is no longer, among intelligent and candid observers, a disputed question. And, in respect to Art, there is no point better established than that practical processes, by becoming more rational have become more certain, and thereby more economical.

Hence it is, that educational establishments, having for their object the training of young men in the various branches of *Theoretical and Applied Science*, respond to a want as generally as it must be earnestly felt in all civilized communities. Such Institutions are well known on the Continent of Europe under titles that, although somewhat varied, are nevertheless suggestive of the objects for which they were established.

SCIENTIFIC AND TECHNICAL INSTITUTIONS IN FRANCE.

The oldest organization bearing the appellation Polytechnic, is an Institution of world-wide celebrity, the ÉCOLE POLYTECHNIQUE—now the École Impériale Polytechnique—of Paris. Established near the close of the last century* by a few accomplished and zealous professors of the

*In 1794—opened in 1795.

Mathematical and Physical Sciences under the fostering care of the French Government,—an especial favorite with the first Emperor Napoleon, from whom it received the most watchful consideration, so long as his ever appreciative sagacity could be made available to its growth in usefulness,—it soon came to be, and, indeed, has been for the last half a century, undoubtedly, in certain respects, the first school of science in the world.

The Polytechnic School of France differs from other institutions of its class, in not furnishing a *complete system* of technical instruction to those who go through its courses. Indeed, this institution is rather to be understood as a *School of General Science*, introductory to a class of *Special Schools of Application*—also government institutions—than as a general Polytechnic Institution; since, the Special or Technical Schools as such being essentially complementary to the École Polytechnique, would have to be joined to the latter in order to the realization of the full idea of a Polytechnic Institute. Such, in fact, is the use made of the École Polytechnique. Its pupils after graduation, with few exceptions, pass directly to the Special Schools, where they complete their courses of pupilage before entering those departments of the Government Service, Military, Naval, or Civil, to which they may be respectively destined.*

The following programme exhibits a general view of the course of study at this institution.

ÉCOLE IMPÉRIALE POLYTECHNIQUE.

[*Course two years.*]

Higher Analysis.
Rational Mechanics.
Theory of Machines.
Descriptive Geometry.
Analytical Geometry.
Astronomy.
Geodesy.
Social Arithmetic.
Physics.
Chemistry.
Architecture.
French Composition.
German Language.
Topographical Drawing.
Free-hand Drawing.
Geometrical Drawing.

The advantages of this School are open to the free competition of natives of France of the proper age. But the standard of requirements for admission, besides being high is rigidly held; so that not unfrequently five or six times as many applicants are examined as found qualified for admission. The course of study is arranged for two years; and, yet, so elevated is the range of some of the studies on the foregoing programme as carried out

*It may be remarked that the École Polytechnique, although under government control and possessed of an interior discipline which is strictly military, is not—as is too frequently supposed—in any proper sense a *Military School.* All instruction bearing directly on subjects of Military and Naval Science, as well as on Civil and Mining Engineering, are excluded from this and referred to the different Special Schools of Application.

at this institution that, with a standard of requirements for admission, particularly in Mathematics, considerably above those required for graduation in many institutions, the École Polytechnique has sent forth among its graduates the first men of France, and, indeed, of the age in Theoretical Science.

It has been mentioned that the École Polytechnique is incomplete in technical specialties.* Provision for this deficiency is, however, very fully made, so far as the requirements of the State are concerned, in the various Schools of Application, under the administrative control of different Ministerial Departments, which furnish courses of special training for the several branches of Government Service. Of these, besides a number of Schools for the several special arms of the Military and Naval Service,—such as Artillery, Cavalry, etc., located in different parts of the Empire,—we have the following Schools for various specialties of the Civil Service:†

L'École des Ponts et Chaussées	3 Écoles Nationales des Arts et Métiers.
L'École Nationale des Mines.	44 Écoles d'Hydrographie.
L'École des Mineurs de Saint-Étienne.	L'École Nationale des Chartes.
L'École des Maitres-ouvriers Mineurs d'Alais.	L'École Impériale Forestière.
Le Conservatoire des Arts et Métiers.	L'École Impériale d'Agriculture.

The School of Roads and Bridges was established as early as the year 1747, but it attained to its present importance at a much later day. Its objects embrace the education of Civil Engineers especially destined for the service of the State, but it also admits "external" pupils to its educational courses who may be otherwise destined. The former class is made up of graduates of the École Polytechnique, while the latter includes any who are able to submit to the somewhat elevated examination requirements prescribed for matriculation in this School. The course of study is arranged for three years, providing for instruction in the construction of common roads, railways, canals, river and harbor improvements, as also of works of drainage, irrigation, and works for the supply of water to towns, mills, etc.‡

---

*An exception in part may be made perhaps in respect to *Civil Architecture*. The courses of the School appear to furnish some special instruction relating to this branch of constructive art.

† *The School of Roads and Bridges* [Civil Engineers].	*Three National Schools of Arts and Trades.*
The National School of Mines.	*Forty-four Schools of Hydrography.*
The School of Miners at Saint-Etienne.	*The National School of Charts.*
The School of Master-miners at Alais.	*The Imperial School of Forestry.*
The Conservatory of Arts and Trades.	*The Imperial School of Agriculture.*

‡ "*Programme, etc., de l' Ecole d' s Ponts et Chausseés.*"—Ministère des Travaux Publics,—*Paris*,—1852.

The National School of Mines at Paris, and the School of Miners at Saint-Étienne, have for a common object the technical education of those destined to the direction or superintendence of Mines and Furnaces, —functions which are generally recognized as appropriate to the profession of the Mining Engineer. The regulations for the reception of a class of graduates from the Polytechnic School, as well as a class of "external" pupils not destined for the State service, are similar, though less restricted, in the National School of Mines, to those which obtain in the School of Roads and Bridges. The School of Miners at Saint-Étienne receives none but external pupils, while its requirements for admission are of a still lower grade. The courses of instruction in these Schools, which are three years in duration, embrace Technical Chemistry, Mineralogy and Geology; the smelting, refining, working and assaying of metals; the surveying, drawing and working of mines. The scientific collections in these Mining Schools are represented to be admirable in every respect. The School of Master-Miners at Alais, is designed for a lower grade of mining service,—as its title indicates, for the education of *master-miners* to an extent sufficient to enable them to comprehend and execute the orders of a Chief, or Mining Engineer.*

The Conservatory of Arts and Trades at Paris, and the three National Schools of Arts and Trades, at Châlons-sur-Marne, Angers, and Aix, constitute an educational system of considerable extent for the instruction of Artisans, the national or provincial schools being under the general superintendence of Gen. Morin, as Director of the Conservatoire. The Conservatoire itself, with its princely endowments and splendid collections, is intended to convey instruction to artisans by means of lectures adapted, with a little preliminary instruction, to the popular mind. The three provincial Schools of Arts and Trades have each a course of three years, with an attendance of about 300 pupils to each School. These Schools are supported at an annual expense to the Government of 300,000 francs each—about $56,000—the students attending which being, for the most part, not only educated but boarded at the expense of the National Treasury. The pupils thus educated, in general, become master-workmen on the public works, or foremen in manufactories and work-shops.†

Our limits do not permit further notice of these Special Government Schools. In order, however, that the liberal views of the French Govern-

---

* "*Programmes, etc., des Ecoles des Mines.*"—Ministère des Travaux Publics,—*Paris*,—1852,

† "*Programme, etc., des Ecoles Nationales des Arts et Métiers.*"—Ministère de l'Agriculture et du Commerce,—*Paris*,—1851.

ment in respect to scientific and technical education may be properly appreciated, it should be understood that, *the tuition is, in general, free* in all of these schools to those who shall become qualified to enter them; and, moreover, that, *to a considerable extent*, the expense of the student's living is also a charge upon the Government Treasury.

Still, these institutions, the Polytechnic School included, being adapted and more or less restricted to government wants, have not been sufficiently available to the nation at large; hence, the desire early felt by the people of France for an institution which should meet their own needs in the educational training of those who might wish to devote themselves to the scientific professions of Engineering, Architecture, Metallurgy, etc. Impelled by the urgency of this want, an enlightened and spirited capitalist, M. Lavallee, founded at Paris, in 1829, a private institution, and devoted a large fortune to investments for its permanent establishment. Thus arose the École Centrale des Arts et Manufactures, now, confessedly, one of the most conspicuous as it is one of the most important of Polytechnic Institutions.

The objects of the École Centrale are declared to embrace the educational training of Civil Engineers, Directors of Works, Superintendents of Manufactories, Professors of Applied Science, etc. Four specialties of instruction are recognized, as follows:

I. Specialty of Mechanicians. — Construction and Establishment of Machines; Mechanic Arts.

II. Specialty of Constructors. — Construction of Edifices and Public Works; Physical Arts.

III. Specialty of Metallurgists. — Mining; Metallurgy.

IV. Specialty of Chemists. — Chemical Manufactures; Manufactures dependent on Chemistry.

The following programme exhibits the general course of study at this institution.

ÉCOLE CENTRALE DES ARTS ET MANUFACTURES.

[*Course three years.*]

Analysis.
Mechanics.
Descriptive Geometry.
Transformations of Motion.
General Physics.
General Chemistry.
Chemical Manipulations.
Hygiene.
Natural History applied to Industry.
Mineralogy and Geology.
Physical Geography.
Working of Mines.
Steam Engines.
Common Roads.
Railways.
Construction of Bridges.
Theory of Stone Cutting.
Architectural Drawing.
Industrial Physics.
Applied Mechanics.
Machines.
Machine Drawing.
Analytical Chemistry.
Industrial Chemistry.
Architecture.
General Metallurgy.
Metallurgy of Iron.
Technology.
Hydraulic Works.
Designs for Works.

To enter this school, applicants must be at least sixteen years of age, and must be found duly qualified in a certain required knowledge of elementary mathematics and drawing. The courses of instruction are obligatory on all, with the exception that a part of the practical exercises in design are allotted to each student in accordance with his choice of one of the four specialties for a future professional career. A feature of this school is the prominence given to drawing and *design*. Students are exercised, as well in the principles, as in the details of professional practice, by being occasionally required to prepare an elaborated design, either for some Construction, or for a Manufacturing Establishment,—for example, a Chemical Works, Pottery, Smelting Works, or something similar.

There are 40 professors and assistants at the present time, with an attendance of 300 students. The number of the latter is, however, limited by the size of the building, which it is in contemplation to remedy, by the erection of larger and more commodious edifices. The annual charges to each student for tuition are 775 francs, about $145, so that the annual revenue of the school from its tuition proceeds alone, amounts to about $44,000. It is worthy of remark, that the Central School, which was established by M. Lavallée with the expectation that it might return to him a fair dividend on his total investment, has fully justified these anticipations, by proving eminently successful as a mere *business speculation*. M. Lavallée still remains, as he has been from the first, the *general* Director of the School—that is, of its financial matters, correspondence, etc. A "*Director of Studies*," (M. Empaytaz,) and nine of the Professors, constitute a "*Council of Studies*," who conduct the general internal administration of the school.

The Government of France was not slow to perceive the manifest promise in such an institution as this. Accordingly, in 1838, the National Budget received an augmentation for the special purpose of maintaining a certain number of students of distinguished aptitude at this school, and the Conseils Généraux of twenty-nine Departments of France have made a similar provision. The estimate in which the Central School is held in France may be best appreciated by an extract from a Report of the Commission of the Chamber of Deputies, appointed to inquire into the Budget for 1838.

"You are aware, Gentlemen," says the Report, "of this useful establishment, founded in 1829, by an association of eminent professors, with the intention of training Civil Engineers, the Directors of Works, the Chiefs of Workshops, and Manufactories. This private institution, which by its importance rivals in excellence our first public [national] establishments, has created and put in practice a complete system of industrial education. It is, at the same time, a supplement to the École Polytechnique, and an addition to our various schools of Applied Science. Such an

institution ministers to one of the first necessities of the age,—hence, its success is complete. This is confirmed, as well by the unanimous opinion of the first manufacturers of the country, as by the facility with which employment is obtained by all of the students who have been trained at the Ecole Centrale."*

One of the most satisfactory tests which can be applied to the working results of any educational establishment, will, in general, be furnished by the statistics of the professional employments of those who were educated at the institution in question. In a late catalogue of some 550 former students of the Central School, we have an instructive illustration of the *tendencies* of this admirable institution, as displayed in the present occupations of these former students, the greater proportion of whom had been regularly *graduated* with the degree of Civil Engineer, while a part had received a certificate only of some special capacity. These employments are classified, as follows: †

Agriculture, Agricultural Engineering,	18
Architecture, Constructions, etc.,	39
Railways,	118
Textile Manufactures,	36
Superintendence, etc., of Public Works,	53
Chemical Arts,	57
Civil Engineering,—general,	56
Machinery	30
Mining and Metallurgy,	79
Manufactures,—Paper, etc.,	22
Industrial and Scientific Instruction,	42

This table sufficiently demonstrates, that the objects of the École Centrale are realized; that the graduates of the school *do* enter upon the practice of those professional pursuits, for which their educational training had been intended to adapt them; and their *success* in these pursuits, is shown in the well known fact, that the graduates of this school are in request not only by manufacturers and managers of works throughout the Empire of France, but also, to a considerable extent, by those of other countries.

Scientific and Technical Institutions in Germany.

Under the usually recognized distinctions of *primary*, *secondary*, and *superior education*, we have the following general classification of educational establishments in the German States.

First, the Primary, comprising all of the *Elementary Schools;* secondly, the Secondary of three kinds, including the *Classical Schools* [Gymnasia], the *Real Schools* [Realschulen], and the *Trade or Artisan Schools* [Gewer-

*"*Ecole Centrale des Arts et Manufactures—Prospectus," etc.,—Paris,*—1852.

† Ibid.

beschulen]; and, thirdly, the Superior, which includes the *Universities* and *Polytechnic Institutes.**

Passing over the primary systems, we may remark of the secondary schools that, the Gymnasia, from having been almost exclusively classical, have, under the reaction of the growing public sentiment, introduced some of the useful sciences [*realities*] into their courses; they are, nevertheless, chiefly classical.† The Real Schools profess a general education, like the Gymnasia, but substitute the modern languages for the ancient; preserving, however, the Latin to a certain extent, and giving more prominence than the Gymnasia to the Physical Sciences. Indeed, the avowed purpose of these establishments was that "not mere words should be taught to the pupils, but realities,—explanations being made to them from nature, from models and plans, and of subjects calculated to be useful in after life."‡ Hence these schools were called "Real Schools,"—a name still preserved. The Gymnasia and Real Schools are, therefore, two parallel, and, for the most part, distinct systems of secondary education,—each having its class of advocates as to their relative merits. Our present object will not permit further reference to these two systems of secondary education. Our main object in referring to them at all has been to call attention to the fact, "that the general character of *all* secondary education in Germany is tending towards giving instruction in the wants of the nineteenth century, rather than stopping at that considered sufficient in the thirteenth, as in many of our classical schools."§

It is, moreover, proper to remark that, what has been said with respect to secondary education, is more or less applicable to the superior systems. The Universities have generally established chairs of some one or more branches of physical science,—in occasional instances of applied science,—thus illustrating a similar tendency among the superior to that displayed by the secondary systems. The Trade or Artisan Schools of the secondary systems, and the Polytechnic Schools or Institutes of the superior, are, however, directly *technical*, as well as scientific, in character. To the consideration of the characteristics of these institutions, we propose to devote a few succeeding observations.

The Trade Schools of Germany hold the general relation of *preparatory* systems to the Polytechnic Schools. But while the latter exist in

---

* Or those of the third class might be termed, respectively, *Humanistic* and *Industrial Universities.*

† The Gymnasia of Germany have their analogues generally in the classical colleges and higher grammar schools of the United States.

‡ Prof. Playfair, — "*Industrial Instruction on the Continent*," — London, — 1852.

§ Ibid.—The remark contained in this quotation seems scarcely less applicable to this country than to Great Britain.

almost every German State, the former have not been so generally established. A brief notice of these institutions, as they find their most characteristic development amidst the enlightened public opinion of Prussia, will convey a more precise idea of their intended objects.

The following programme exhibits the general course of study of two years in the Prussian Lower Technical or Trade Schools:—

Synthetic Geometry.	Physics.
Descriptive Geometry.	Mechanics and Machinery.
Elementary Algebra.	Chemistry.
Practical Arithmetic.	Chemical Manipulations.
Land Surveying.	Mineralogy.
Plane Trigonometry.	Chemical Technology.
Use of Logarithms.	Architecture and Building Plans.
Mensuration.	Mechanical Technology.
Free-hand Drawing.	Geometrical Drawing.

The subjects of study, whether theoretical or practical, being pursued only through their elements, and this being thoroughly done, it is manifest that the course above presented, of the Trade Schools of Prussia, adapts them admirably to the purpose of schools of preparation for the higher Polytechnic establishments. It may be thought, at first sight, that these schools are deficient in certain fundamental studies, but it should be borne in mind that the requirements for admission to the Prussian Trade Schools, are as follows:—an age of fourteen years,—a good primary education in the vernacular language,—a thorough understanding of the elements of arithmetic,—and a fair degree of proficiency in free-hand drawing. In point of fact, the age for admission is such that the greater part of those who enter the Trade Schools have previously had an educational course in the Real Schools.

In general, these schools are supported in part by the State, the balance being derived either from a small tuition fee, or from local endowments.—According to Professor Playfair's recent observations, there are twenty-six Technical or Trade Schools in Prussia, three in Saxony, and twenty-six in Bavaria; while the statistics of these schools show that in Prussia there are 1200 students, and in Bavaria 3000, who are annually receiving the benefits of this eminently valuable course of educational training.* And,

*"Industrial Instruction on the Continent." It should be remarked, however, that there appears to be an organized system of Trade Schools in the kingdom of Hanover, which have their culminating point in the Polytechnic School at the capital. According to Prof. Karmarsch, there are twenty-two Trade Schools in the kingdom of Hanover, in regard to which he gives from the report of the "Königlichen Verwaltungs-Kommission der Gewerbeschulen" for 1843, certain statistics, from which it appears that, in 1836, there were 84 Instructors and 1805 students in these Schools, and in 1843, there were 102 Instructors and 2840 students —an average of 130 to each school. These schools are mainly supported from the Royal Treasury. In a few instances, municipal appropriations are made, and small tuition fees are paid by the students.—*Karmarsch,—Anhang, "Die höheren Gewerbeschulen in Hanover."—Hanover,*—1845.

although these institutions may be considered natural nurseries of future students of the Polytechnic Institutes, still, a large proportion of the students of the Trade Schools finish their days of pupilage in these establishments, and enter at once on the practical pursuits of life, as masons, builders, and artisans in various industrial pursuits.

With these remarks on the subject of the Secondary Technical Schools of Germany, we proceed to the consideration of the higher Polytechnic Institutions.

Prussia.

Besides several special schools for Engineers, Architects, etc., in different parts of Prussia, there is a general institution of considerable celebrity which was established in 1821, at Berlin, under the name of the "Königliches Gewerbe Institut,"—*Royal Trade Institute.* This Institution was originally intended to fulfil the purpose of a Central Technical School,—by presenting a more elevated course of training than that given at the various Secondary Technical Schools. It was, moreover, originally designed to give instruction by means of work-shops in certain mechanical crafts,—a feature which was preserved for some twenty-five years, but has recently been given up, in a late reörganization of this Institute, on conviction of its practical unsoundness. At the present time, the objects of the Technical Institute are substantially identical with those of the Central School of France and other Polytechnic Institutions; that is, these objects are stated to embrace the education of Engineers, Architects, Mechanists, and Managers of Manufactories and Chemical Works.

The following programme exhibits the course of study at this Institution.

KÖNIGLICHES GEWERBE INSTITUT.

[*Course three years.*]

General Course.

Higher Algebra.
Stereometry.
Spherical Trigonometry.
Analytical Geometry.
Differential and Integral Calculus.
Descriptive Geometry.
Free-hand Drawing.
Geometrical Drawing.
Machine Drawing.
Special Physics.
Special Chemistry.
Mineralogy.
Pure Mechanics.
Applied Mechanics.
Materials used in Construction.
Laws of Architecture.
Architectural Drawing.
Practical Calculations.

Special Courses.

A.—For Mechanists and Civil Engineers.

Theory of Construction and of Machines.
Steam Engines and other Motors.
Practice in Workshops.
Railways and Buildings.
Technology.
Designs and estimates for Machines.

B.—For Chemists.

Chemical Technology.	Machine Drawing and Designs.
Analytical Chemistry.	Laboratory Practice.

C.—For Architects and Builders.

Free-hand Drawing.	Heating and warming arrangements.
Architectural Drawing.	Architectural Designs.
Modelling in Clay.	Theory of Stone cutting.
Modelling of Buildings in plaster, wood, and stone.	Designs for Buildings in stone, brick, and wood.

The instruction given in the General School is a common basis of the courses given in the Special Schools,—the class after having completed the general course being resolved into the three Technical Sections named above, in accordance with the predilections of its different members.

For admission to the Technical Institute, the candidate must present a "maturity" certificate from a Secondary School, or submit to an examination of an equally elevated grade. Indeed, the requirements for admission are such as to secure a body of students prepared to advance, at once, into the higher departments of scientific education. With the well-known names of its present Director, (Drückenmüller,) and his staff of Professors,* the character of the instruction, as might be expected, though eminently practical, is at the same time highly scientific.

The collections of Drawings and Models of Machines and of Architectural and Engineering Works; the collection of casts of Works of Art; and the collections and appliances generally applicable to the educational purposes of the Technical Institute of Berlin, are mentioned in terms of high admiration by those who have seen them.

The Technical Institute of Berlin is supported wholly by the Government, at an annual expense of 45,000 thalers, or about $35,000. Not only is its instruction gratuitous, but 50 out of 170 students—its total number—receive about $150 each, for living expenses; in addition to which the Government appropriates about $5000 annually, for traveling expenses of certain students on foreign tours,—both professors and students being occasionally sent to foreign countries, to acquire a knowledge of recent inventions in the Arts.†

---

*Wölf—Mathematics,
Dove—Physics.
Rammelsberg—Chemistry.
Magnus—Technology.
Wiebe and Fink—Machinery.
Söhde and Manger—Architecture.
Freiberg—Free-hand Drawing.
Pohlke—Geometrical Drawing.
Kiss—Modelling.
Boettlicher—Design.

† Prof. Playfair,—"*Industrial Instruction*"; also, Prof. Bache,—"*Report on Education in Europe*,"—Philadelphia,—1839.

Austria.

The "Polytechnisches Institut" [*Polytechnic Institute*] at Vienna, the largest institution of its class in Europe, was established in 1815 by command of the Emperor Francis I. Its present buildings, embracing an extensive double quadrangle of most imposing palatial architecture, were finished in 1838, at a cost of 759,384 florins—over $300,000; and its Scientific and Technical Collections, as, indeed, its appointments generally as an educational institution, are on a similar scale of princely magnificence.

The educational objects of the Polytechnic Institute comprise the education of Architects, Engineers, Manufacturers,* and Merchants. In addition to these, however, the Institute is made a National Conservatory of Arts and Manufactures, with permanent collections, and is also intended to discharge the functions of an Institute for the promotion of National Industry, by means of occasional exhibitions of the products of Manufactures, held under the direction of the Institute. The permanent collections of the Conservatory of Arts are used for instruction in the Institute.

In the organization of the Austrian Institution we recognize, first, a Real or Preparatory School; and, secondly, the Polytechnic Institute proper, which includes two sections, namely, a Technical Section for Architects, Engineers, etc., and a Commercial Section for Merchants.

The following programme exhibits the courses of instruction of this institution.

POLYTECHNISCHES INSTITUT.

A.—Realschule.

[*Course two years.*]

Religion.
German Composition and Style.
French language.
Italian Language.
Geography.
Natural History.
Mineralogy.
Mathematics.
Calligraphy.
Drawing.

B.—Polytechnisches Institut.

1.—Technical Section.

[*Course five years.*]

Elementary Mathematics.
Higher Mathematics.
Lower Geodesy.
Topographical Drawing.
Technology.
Agriculture.
Hydraulic Works.
Construction of Roads.

---

*Preparatory to a future superintendence of Manufactories, etc., of the Austrian Empire,—such as Distilleries, Chemical Works, Glass and Porcelain Works, Sugar Manufactories, Metallurgic and Iron Works.

Mechanics.	Architecture.
Theory and Construction of Machines.	Technical Chemistry.
Descriptive Geometry.	Analytical Chemistry.
Mineralogy and Geology.	Practical Chemistry.
Physics.	Architectural Drawing.
General Chemistry.	Machine Drawing.

2.—Commercial Section.

German Style and Composition.	Mercantile Correspondence.
Commercial Science.	Book-keeping.
Commercial Law,	Raw Materials and Products.
Commercial Arithmetic.	Mercantile Geography.

Besides the foregoing, there is—under the direction of the Institute—a "Technical Drawing Section" or Technical School of Design, and a "Popular Section" or Sunday School.*

The number of students attending the several schools of the Polytechnic Institute of Vienna, during the fall of 1852,† was as follows:—

In systematic courses,		In occasional courses,	
Preparatory School,	419	Technical Drawing Section,	360
Technical School,	1092	Sunday Section,	1381
Commercial School,	126		
Total,	1637	Total,	1741
		In both	3378

The number of professors and teachers engaged in this Institute amounts to 58, exclusive of the executive staff of the Director. The annual revenue of the Institute is about 116,000 florins—$48,000—of which about $34,000 is given by the State, and the balance comes from the funds of the school. The instruction is nearly gratuitous, there being only a small entrance fee charged for attendance on any of the courses of instruction.

It is sufficiently evident that the Polytechnic Institute of Vienna is on a very large scale. And it has been largely successful. Its course of study is extensive, though less systematic in its arrangement, and less strictly carried out than in some of the other Polytechnic Institutions; and yet, notwithstanding these defects and the large number of students attending this Institute, the demand for them by industrial establishments is said to be greater than can be readily supplied.

Besides the Metropolitan Institute at Vienna, there are five provincial Polytechnic Schools in Austria, the number of students in which in 1852, being about 4000. Of these, the one at Prague, the capital of Bohemia, under the title of the "Technische böhmische stændische Lehran-

---

* *Sunday Schools* for secular rather than religious instruction, in accordance with the habits very generally of the nations on the continent of Europe.

†Prof. Playfair,—"*Industrial Instruction, etc.*" Dr. Schödler,—"*Die höheren technischen Schulen nach ihrer Idee und Bedeutung,*"—*Braunschweig,*—1847.

STALT,"* is one of the oldest of its kind in Germany, having been established by the Bohemian Nobles as early as the year 1806.

The Technishe Lehranstalt has for its objects, the education of Officers of State, whose functions connect them with the concerns of national industry; the education of Architects, Engineers, and Machinists; and the education of those destined to the superintendence of Glass and Porcelain Works, Metallurgic Works, Sugar Works, etc.

The institution consists of a Real or Preparatory School and Technical School proper—with courses of instruction of two and three years respectively. The course of the latter is seen in the following programme.

TECHNISCHE LEHRANSTALT.

[*Course three years.*]

Religion.	Special Technical Chemistry.
Elementary Mathematics.	Constructions.
Physics,	Construction of Roads.
Zoölogy and Botany.	Agriculture.
General Technical Chemistry,	Agricultural Economy.
Mineralogy.	Architectural Drawing.
Practical Geometry,	Machine Drawing.
Mechanics.	Topographical Drawing.

Besides 10 instructors in the Real or Preparatory School, there are 12 professors and adjuncts, in addition to the Director, in the Technische Lehranstalt. The whole number of students in attendance in 1847 was 1600.

The yearly appropriation to the support of the institution is Fl. 28,759, or $11,300. The tuition fees are Fl. 18, or $7.20 per annum.†

Bavaria.

It has been already mentioned, when speaking of the lower Technical or Trade Schools of Germany, that there are twenty-six of these schools in Bavaria alone. These schools have courses of three years each—receiving pupils from the age of twelve to fifteen years—of a character to adapt them admirably well to discharge the functions of preparatory schools for the higher technical institutions. Of these, there are three "Polytechnic Schools" at Munich, Augsburg, and Nurnberg; two "Commercial Schools" at Furt and Nurnberg; and a "Building School"‡ at Munich.

The "Polytechnische Schule zu München" [*Polytechnic School at Munich*]—the oldest of these—was established in 1827, for the education of Technists, and for the scientific preparation of those destined to the

---

*Technical Institution of the Bohemian Nobles.

†Dr. Schödler,—"*Die höheren technischen Schulen.*"

‡*Bauschule;* a school for the technical instruction of *builders*,—carpenters, masons, decorators, etc.—in drawing, modelling, embossing, use of materials, etc.—This school is said to be a model of its kind.

Civil Offices of the State. In its organization it comprises a Preparatory School [Kreislandwirtschafts-und Gewerbschule*] and the Polytechnic School proper, both located in the same building. The following programme presents the course of study of this institution.

POLYTECHNISCHE SCHULE ZU MÜNCHEN.

I. Kreislandwirthschafts-und Gewerbschule.

[*Course three years.*]

Religion.
History.
Geography.
German Language.
Book-keeping.
Algebra.
Descriptive Geometry.
Trigonometry.
Chemistry.
Natural History.
Physics.
Mechanics.
Trade-knowledge.†
Agriculture.
Drawing.
Embossing.
Modelling.

II. Polytechnische Schule.

[*Course four years.*]

Analysis—Theory of Equations and Functions; Series; Analytical Polygonometry; Plane and Spherical Trigonometry; Analytical Geometry.
Physics.
Machines and Machine Drawing.
Differential and Integral Calculus.
Materials used in Construction.
Applied Mechanics.
Analytical Chemistry.
Constructions—Roads, Bridges and Water-works.
Geodesy and Topographical Drawing.
Architectural Drawing.
Descriptive Geometry.
Analytical Mechanics.
General Chemistry.
Designs for Constructions.
Stone-cutting.

The "Polytechnische Schule zu Augsburg" [*Polytechnic School at Augsburg*] was established by Royal Ordinance in 1833. It has for its objects the conveying of scientific and technical instruction on the following subjects:‡

1. Mining, Metallurgic and Salt Operations.
2. Civil Architecture
3. Roads and Hydraulic Works.
4. Higher Forestry.
5. Plastic Arts.

In its organization it comprises a Preparatory School [Kreisgewerbschule §] and the Polytechnic School proper, both in the same building. Without, however, giving further details, it may be remarked that the courses of study of the Polytechnic Schools at Augsburg and Nurnberg are substantially the same, both being somewhat inferior in these as in other respects to the School at Munich. According to Prof. Playfair,‖ the

---

* *Local Farming and Trade School.* † *Gewerblehre.*

‡ Dr. Schödler,—"*Die höheren technischen Schulen nach ihrer Idee und Bedeutung.*"

§ *Local Trade School.*

‖ "*Industrial Instruction on the Continent.*"

specialties of these Schools, or the excellences which they respectively exhibit, are, Architecture and Civil Engineering at Munich, Machinery at Augsburg, and Technical Chemistry at Nurnberg.

These Schools are mainly supported by Government, which appropriates 39,000 florins [$16,250] yearly, in addition to which a small tuition fee is charged. The buildings of the Polytechnic Schools are described as being very ample; while some of the scientific collections, particularly at Munich, are said to be of a high order of excellence.

In the Munich Polytechnic School there are 15 professors and 344 students; there are also 205 students in the Preparatory School. In 1852, there were in the three Polytechnic Schools 34 professors and assistants, and 481 students in attendance.

The excellence of the Architecture and Engineering of Bavaria is well known to intelligent observers, and is directly traceable to the influence of the admirable Polytechnic Institutions, established and largely sustained by the enlightened liberality of the Royal Government of that State.

Saxony.

The system of scientific and technical education of the kingdom of Saxony, has a similarly elevated rank to that which has long been accorded to its humanistic or literary counterpart. In both, Saxony takes its place among the first of the German States. The lower Technical Schools, of which there are three, located respectively at Chemnitz, Plauen, and Zittau, are of a high grade of excellence. Of these, the one at Chemnitz is quite a remarkable specimen of its class, and seems to warrant something more than a passing notice.

The "Königliche Gewerb–und Baugewerkenschule zu Chemnitz" [*Royal Trade and Building School at Chemnitz*] comprises two schools—a Trade and Building School. The following programme gives the course of study for each school.

KÖNIGLICHE GEWERB–UND BAUGEWERKENSCHULE ZU CHEMNITZ.

I.—Gewerbschule.

[*Course four years.*]

General Arithmetic.
Geometry.
Plain and Spherical Trigonometry.
Theory of the Higher Equations.
Analytical Geometry.
Commercial Arithmetic.
Physics.
General Chemistry.
Natural History.
Chemical Manipulation.
Analytical Chemistry.
Mineralogy and Geology.
Descriptive Geometry.
Perspective.

Geometrical Drawing.
Architectural Drawing.
Machine Drawing.
Surveying and Plan Drawing.
Free-hand Drawing.
Mechanics and Machinery.
Culture of Field Stock.
Science of Construction.
Mechanical Technology.
Agricultural Machinery.
Agricultural Architecture.
Agricultural Chemistry.
Agricultural Excursions.

Agricultural Economy.
Cattle-Breeding.
Plant Culture.
Study of Soils and Fertilizers.
Technical Chemistry.
Commercial Book-Keeping.
Spinning Machines.
Fabric and Pattern-drawing.
Embossing in Clay and Wax.
German Language.
Geography and History.
French Language.
English Language.

II.—Baugewerkenschule.

[*Course two years.*]

Arithmetic.
Geometry.
Geometrical Projections.
German Language.
Mechanical Physics.
Special Masonry and Carpentry of Road, Bridge, and Hydraulic Constructions.

General Architecture.
Architectural Drawing.
Free-hand Drawing.
Ornamental Drawing.
Modelling in clay and wood.
Perspective.
Embossing of Ornaments, &c., in clay.

There were in the Chemnitz School in 1853, 16 professors and assistants.

Students in the Trade School,	192.
" " Special Drawing Class,	53.
" " Building School	59.
Total,	304.

The instruction in this School commences with the elements of the subject taught; and, in fact, the aim appears to be to carry this instruction no farther than to secure a good theoretical and practical knowledge of *the elements* of the various subjects embraced in this somewhat extensive programme. If we may judge from the character of the courses of study here presented and of the modes in which they are said to be carried out in these schools,* there can be no doubt of their capability of furnishing an admirable training for agriculturists, artisans, builders, etc., as also of their peculiar excellence as training or preparatory schools for the higher Technical Institutions.

There are two Higher Technical Schools in Saxony; one the "Königliche Polytechnische Schule" [*Royal Polytechnic School*] at Dresden; the other the "Königl. sächsische Bergakademie" [*Royal Saxon Mining Academy*] at Freiberg.

* Director Schnedermann,—"*Nachrichten über die Königl. Gewerb-und Baugewerkenschule.*"—*Leipzig*,—1853.

The former of these Schools was established at the capital of the kingdom of Saxony, more than twenty years ago, under the name originally of the "Technische Bildungsanstalt zu Dresden"—[*Technical Institution at Dresden*]. It was recently reörganized, when it took its present name. Besides the Polytechnic School there is a "Königl. Baugewerkenschule" [*Royal Building School*] under the same general organization. The Polytechnic School comprises a "Lower" and an "Upper Section." The following programmes exhibit the respective courses of study, of these two schools.

KÖNIGLICHE POLYTECHNISCHE SCHULE.

I.—Lower Section.

[*Course three years.*]

Stereometry.
Trigonometry.
Algebra.
Mechanics.
Natural History.
Theoretical Chemistry.
Experimental Physics.
Practical Geometry.
Descriptive Geometry.
Analytical Geometry.
Mineralogy.
Architectural Drawing.
Architectural Science.
Logic.
French Language.
German Composition.
Machines.
Perspective.
Machine Drawing.
Plan Drawing.
Modelling in Wood.
Field Surveying.
Technology.
Chemical Manipulation.
Technical Chemistry.
Ornamental Drawing.

II.—Upper Section.

[*Course two years.*]

German Composition.
Logic.
National Economy.
Popular Jurisprudence.
English Language.
Book-keeping.
Higher Analysis.
Higher Physics.
Astronomy.
Geology.
Mill Machinery.
Motive Powers.
Constructions.
Designs for Machines.
Higher Geodesy.
Higher Mechanics.
Technology.
Roads and Railways.
Hydraulic Engineering.
Practical Surveying.
Topographical Drawing.
Designs for Buildings.
Technical Chemistry.
Geological Excursions.

Königliche Baugewerkenschule.

[*Course three years.*]

Arithmetic.
Mechanics.
Building and Carpentry.
Architectural Drawing.

Geometry.	Building Economy.
German Composition.	Ornamental Drawing.
Industrial Physics.	Designs and Estimates.
Perspective.	Architectural Science.

It will be observed that a different principle of subordination is recognized by the managers of the Dresden Polytechnic School to that which obtains in the German Schools previously considered. The Under Section in itself presents a general Scientific and Technical Course of instruction. The differences between the course of this and that of the Upper Section, are partly, in the addition of certain scientific and technical subjects to the latter, and in part, in the development and specializing of subjects taught in the Under Section. The Course of the Under Section is, indeed, very well adapted to the wants of those who might wish to pursue a general course of scientific education, without reference to the wants of those professions for which the Course of the Upper Section is more especially designed. Such, in fact, appears to be in part the use made of the Under Section in this Polytechnic establishment;—it serves as a preparatory department to the Upper Section for those who are to be Engineers, Machinists, and Chemists, and it supplies a finishing course for those who wish a mere accomplishment in the less severe and less technical studies of theoretical and practical science.

In 1853, there were in the Polytechnic School, 22 professors and assistants; also,

Students in Under Section,	162.
Students in Upper Section,	43.
Students in Special Drawing and Modelling,	18.
Students in Building School,	86.
Total.	309.*

The annual revenue of the Dresden establishment is only about $12,000 of which from $8000 to $9000 are appropriated by the Government, and the balance comes from a small tuition charge of about $23, annually.†

In addition to the Polytechnic School of Dresden, Saxony contains the most celebrated School of Mines in the world. The *Royal Saxon Mining Academy* of Freiberg, is not only the oldest,—having been established in 1765—but pre-eminently the first institution of its kind, in experience and other resources, for the accomplishment of its objects.

In its organization, the Mining Academy comprises a General or Preparatory School, and the two specialties of Mining and Metallurgic Schools. The following programme exhibits the courses of study at this institution.

---

* Director Hülse,—"*Nachrichten über die Königl. polytechnische Schule und Königl. Baugewerkenschule,*"—*Dresden,*—1853.

† Prof. Playfair,—"*Industrial Education, etc.*"

KÖNIGLICHE SÄCHSISCHE BERGAKADEMIE.

[*Course four years.*]

General Course.

Mathematics—Elementary, Higher and Practical.
Mechanics—Theoretical and Practical.
Machines—Mining and Metallurgic.
Chemistry — Theoretical, Analytical, and Practical.
Physics—General and Applied.
Descriptive Geometry, including Shades Shadows and Perspective.
Drawing—General and Topographical, extended to Mining Implements, Mining and Metallurgic Machines and Constructions.
Mineralogy—Systematic and Practical.
Geology—Systematic and Practical.
Civil Architecture and Engineering Constructions.
Mining Jurisprudence and Correspondence.
German Composition.
French Language.
General Metallurgy.
The Art of Mining.
Crystallography.
Land Surveying and Mapping.

Special Courses.

For Miners.

Mine Surveying and Mapping.
Fossil Geology.
Keeping of Books, Registers, &c.
Mine Working.

For Metallurgists.

Practical Assaying.
Analysis of Metallic Ores.
Practical Metallurgy.
Blow-pipe Assaying.

For admission to the Saxon Mining Academy, applicants must be not less than sixteen years of age, and must be prepared to pass an examination in certain required subjects of preliminary knowledge. The course of study of the Academy is arranged for four years, and is obligatory on all its students, with the exception of certain specialties in Mining and Metallurgy, which are pursued in accordance with the student's destination to one or the other of these two departments of professional practice.

This institution is supported by Government, from which it receives liberal provisions. A part of the students not only receive their instruction and board, but in addition, a certain pay per annum. These enter the Government Service with their appointments to the School, and when graduated are candidates for the Royal Corps of Mines. As such they receive the pay of this grade until appointed to vacant places in the Corps. Besides this class of students, others are permitted to attend the Mining Academy, who pay a small tuition fee and board in the town at their own expense. In this latter class are to be found students not only from Saxony and the other German States, but from nearly every country of the civilized world. The attendance, however, is never very large, varying from fifty to seventy-five of all kinds.

In a late General Catalogue of former members of the Mining Academy,

there are 1681 names from A. D. 1766 to 1850, embracing men from all parts of Europe, with some from the United States, Mexico, and the South American States. It appears, moreover, from the statistics obtained by the compilers of this Catalogue that, not only the foreigners who have attended the courses of this School, but a considerable number of its German graduates, have gone into every land, legitimately carrying out the teachings of their Alma Mater as Miners and Metallurgists,—as missionaries, indeed, of these important departments of Practical and Technical Science.*

The Professorial Corps of this institution has long been celebrated. Such names as WERNER†, BREITHAUPT LAMPADIUS, MOHS, LEHMANN, and others among the earlier, and WEISBACH, PLATTNER, SCHEERER, COTTA, and others—fourteen in all—among the present Professors, in the Mining Academy, are well known in the annals of theoretical and practical science.

BADEN.

In Baden the Trade or Artisan's Schools appear to be of a less elevated grade than in most other parts of Germany. There is, however, a Polytechnic Institution at Carlsruhe, the Capital of the Grand Duchy, which is one of the most complete in its organization, as well as one of the most important in its results of any in Germany. It was established in 1825 under the Governmental charge of the Minister of the Interior. In 1832 it underwent a reörganization; and, subsequently, other less important changes were introduced until it finally took the form which it has had for a number of years past.

Its educational objects will be rendered sufficiently apparent by the following statement of its present organization, in connection with its several courses of study.

POLYTECHNISCHE SCHULE ZU CARLSRUHE.

GENERAL MATHEMATICAL CLASSES.

Religion.	Practical Geometry.
History.	Differential and Integral Calculus.
German Language.	Mechanics.
French Language.	Botany.
English Language.	Mineralogy and Geology.

---

* "*Die Bergakademie zu Freiberg: zur Erinnerung an die Feier des hundert järigen Geburtstages* WERNER'S *am* 25, *Sept.* 1850."—*Freiberg.*

Also, "*Die Bergakademie zu Freiberg, ihre Beschränkung oder Erweiterung, beleuchtet von B. Cotta, Professor an derselben.*"—*Freiberg*,—1849.

† WERNER, one of the distinguished fathers of Geological Science. He was one of the earliest Professors in this School—having been appointed in 1774—and remained as its most celebrated teacher until his death in 1817. His cabinet—the Wernerian Museum—is one of the valuable scientific collections possessed by this institution.

Pure Mathematics.
Geometry.
Trigonometry.
Descriptive Geometry.
Analytical Geometry.
Physics.
Technical Chemistry in general.
Free-hand Drawing.
Calligraphy.
Modelling.

SPECIAL SCHOOLS.*

I.—Engineering School.

[*Course three years.*]

Ethics.
English Language.
Jurisprudence.
Practical Surveying.
Higher Geodesy.
Topographical Drawing.
Designs and Estimates for Works.
Landscape Drawing.
Higher Analysis.
Higher Mechanics.
Roads and Hydraulic Works.
Machinery.
Architectural Drawing and Modelling.
Higher Architecture.

II.—Architectural School.

[*Course four years.*]

German Literature and Style.
Ethics and Æsthetics.
Archæology of Art.
Higher Architecture; History; Styles.
Jurisprudence [*Populare Rechtslehre.*]
Trigonometry, Spherical and Analytical Geometry.
Differential and Integral Calculus.
Mechanics and Hydraulics.
Descriptive Geometry.
Theory of Machines.
Designs for Buildings,—Estimates.
Technical Architecture.
Construction of Roads and Hydraulic Works.
Mineralogy and Chemistry.
Building and Ornamental Drawing.
Drawing of Constructions.
Figure Drawing.
Aerial Perspective.
General Modelling.
Modelling Ornamental.

III.—Higher Technical School.

[*Course two years.*]

For Technical Chemists.

General Chemistry.
Analytical Chemistry.
Practical Geometry.
Ethics.
Chemical Manipulation.
English Language.
French Language.
Botany and Zoölogy.
General Drawing.
Technical Chemistry.
Popular Mechanics.
Common Roads.
History.
Mineralogy.
Geology.
Book-keeping.
Commercial Law.
Mechanics of Transport.

For Mechanists and Technologists.

Theory of Machines.
Construction of Machines.
Physics.
Higher Analysis.
Higher Mechanics.
Technology.
Technical Chemistry.
English Language.
Roads, Bridges, and Hydraulic Works.
French Language.

---

* "*Fachschulen.*"

IV.—Forest School.

[*Course two years.*]

Practical Mathematics.
Technical Chemistry.
Botany.
Practical Geometry.
National Economy.
Forest Trees.
Forest Laws and Police.
Wood Taxation.
Mineralogy.
Geology.
Meteorology.
Road Making.
Agricultural Chemistry.
Forest Economy.
Forest Rights and Sports.
Preservation of Forests.

V.—Commercial School.

For Commerce.

[*Course one year.*]

Commercial Law.
Book-keeping.
History of Commerce.
German Composition.
French Language.
English Language.
Commercial Correspondence.
Commercial Arithmetic.
Commercial Products.
Commercial Geography.
Calligraphy.
Drawing.

For Postal Service.

[*Course two years.*]

Arithmetic.
Geography.
Religion.
French Language.
French Commerce.
National Economy.
English Language.
Calligraphy.
Ethics.
Popular Mechanics.
Physics.
General History.
German Composition.
Political Arithmetic.
Jurisprudence.
Mechanics of Transport.
Commercial Contracts.
Æsthetics.

Students may enter the lowest class of the General School or Mathematical Classes at fifteen years of age, with a certain required preparation. It should be observed, however, that the General School more appropriately precedes the courses of the Special Schools of Engineers, Architects, and Technists. The other Special Schools require a much lower standard of preparation, than that obtainable during the three years course of the General School.*

In 1852–3, there were 41 professors and teachers attached to this institution, with an attendance of 330 students, of whom 112 were foreigners,—72 from other German States, and 40 from other European nations.

The Government grant to the Polytechnic School of Carlsruhe is only 32,000 florins per annum,—about $14,000,—while the expenses of the School amount to 50,000 florins—about $21,000. To meet this deficiency a small charge is made to each student,—$33,00 per annum.

---

* "*Das höhere und niedere Studien-Wesen im Grossherzogthume Baden*,"—*Konstanz*,—1846. Also, Dr. Schödler,—"*Die höheren technischen Schulen etc.*"

Of the results of this institution, it is said that the formal certificates of the Special Schools are held in the highest estimation, and command immediate employment to their possessors.*

In addition to the institutions already noticed, there are excellent establishments of the same class, in Hanover,† Wirtemberg, Hesse-Cassel, Hesse-Darmstadt, Brunswick,‡ and possibly in other parts of Germany, of which the writer possesses no information.§ Our limits, however, do not permit further citations of this kind; and, indeed, our present objects will be satisfied, we trust, with the introduction of the examples already given. They have been chosen, partly on account of their prominence in this class of institutions, and in part, for their well marked peculiarities; for although all aiming at the same general objects,—frequently, at objects precisely the same,—yet, they differ much in organization, in methods, and in the general spirit which animates their administration.

In the sketches which have here been given, the aim has been to present certain classes of characteristics, in as concise a form as practicable, to the exclusion of much other matter that might be interesting to the immediate managers of this class of educational institutions, but which would be scarcely essential to our present inquiry. Of the features thus brought under review, we have intended, especially, to include the age or duration of the institution,—the nature of its establishment,—objects,—organization,—courses of study,—number of instructors,—number of students,—endowments,—tuition expenses,—besides an occasional remark illustrative of its characteristics or the results of its practical working.

---

* Prof. Playfair,—"*Industrial Instruction.*"

† Director Karmarsch,—"*Die höhere technische Schule zu Hanover,*"—*Hanover,*—1844;—Also by the same, "*Die polytechnische Schule zu Hanover,—Hanover,*—1848.

‡ Prof. Schödler,—*Die höheren technischen Schulen, etc.*"

§ In Belgium, Denmark, and several other Continental States, there are provisions of greater or less extent for scientific combined with technical instruction. In Great Britain, there were no institutions for this kind of instruction,—with the exception of two or three schools of Civil Engineering,—prior to the advent of the London Industrial Exhibition of 1851. Since then, the Government has not only established a School of Mining Engineers, but has been building up a system of schools of General and Technical Design all over the Kingdom.

THE TRUE IDEA OF A POLYTECHNIC INSTITUTE.

We shall now seek to realize the more prominent object, originally proposed, for bringing together the preceding notices of the principal Scientific and Technical Institutions of the Continent of Europe,—which was, to illustrate the *true idea* of the Polytechnic Institute, by a direct appeal to its own most characteristic features, as displayed in a series of institutions presenting all the usual varieties of the class. The features most appropriate to this purpose are those which will best illustrate the Objects, Curriculum, and Methods of the Polytechnic Institute,—characters which may be obtained by simple inductions based on the data supplied by the foregoing sketches.

Objects.

By a comparison of the different institutions embraced in our survey, it will be seen that their general objects may be properly stated to embrace the educational training of the following classes of Scientific Technists.

1. Architects.*
2. Civil Engineers.†
3. Mining Engineers.‡
4. Mechanists.§
5. Technologists.‖
6. Technical Chemists.¶

---

* Whose duties connect them with the preparation of Designs and Superintendence of the Construction of *Edifices*, public and private.

† Having charge of the following specialties: Designs and Constructions of,—*Common Roads; Railways; Bridges; Tunnels; Canals; Docks; River and Harbor Improvements; Lighthouses; the Supply and Distribution of Water for Towns, Sanitary, Agritultural, and Manufacturing purposes.*

‡ Under Mining Engineering is usually included the two important specialties of *Mining* and *Metallurgy*,—embracing all that relates to the Surveying, Opening, and Working of Mines, and the Smelting of Ores, Reduction of Metals, Assaying, etc.

§ Or *Higher Machinists;* also sometimes called *Mechanical Engineers* in Great Britain and the United States. Their professional functions embrace the Designing for, and Superintending of the Construction of the Steam Engine, Hydraulic, and other Machine Motors, as also heavy and complicated Machinery in general.

‖ Whose functions embrace those professional duties incident to the Establishment and Superintendence of Works for the Higher Manufactures and Physical Arts; such, for example, as Potteries, Porcelain and Glass Works; Manufactories of the various Textile Fabrics, Printed Fabrics, Ornamental Metal Work, etc.

¶ These include two classes, namely; first, those engaged in *Chemical Manufactures*, for example, in the production of Acids, Salts, Pigments, Coloring Substances, Oils, Fats, Resins, Sugars, etc.,—Preparation of Fuels, Illuminating Gases, Pharmaceutical Substances, etc.; secondly, those engaged in *Manufactures dependent on Chemistry*,—such as Bleaching, Dyeing, Printing on Textile Fabrics, etc.

In this generalization we have omitted all recognition of Schools of Forestry, Agriculture, and Commerce, because neither occurs in more than one or two instances in the whole number of institutions noticed. Besides, a School of Forestry, as here represented, is naturally limited to the wants of a few countries; while a School of Agriculture, with its peculiar requirements in respect to educational appliances would, in the majority of cases, as a matter of expediency, have a distinct organization.* There is, however, no reason why a Commercial School with elevated aims should not form one of the schools of a Polytechnic Institution. The relations between the pursuits of commerce and the various operations and results of constructive, productive, and manufacturing industry, are certainly such as to make the facilities possessed by a Polytechnic Institute peculiarly well adapted to the development of the most useful kind of commercial education. The course of the Commercial Section in the Polytechnic School of Carlsruhe is, in this connection, eminently suggestive.

The Curriculum.

We may conveniently divide the system of instruction of a Polytechnic Institution into three parts;—first, the *Preparatory Course*, embracing all those studies necessary to matriculation in the institution; secondly, the *General Course*, constituting the foundation in general science and literature, on which, as a common basis, are erected the subsequent courses; and thirdly, the *Technical Courses*, which include all those special teachings, more or less peculiar to the objects of the institution.

The scholastic requirements for matriculation differ considerably among the institutions which have come under our notice; some, as in the case of the Polytechnic School at Paris and the Technical Institute at Berlin, have requirements, particularly the former, of an extremely elevated grade; while others, which embrace the majority of cases, prescribe a certain measure of preliminary training which experience has found to be both necessary and practicable. The following programme presents the course of preparatory studies *generally* required for matriculation in the Polytechnic Institutions of the Continent of Europe.

---

* A considerable proportion of the subjects of study at the Schools of Forestry on the Continent of Europe, is manifestly such as should form a part of the general course of study in every completely organized Agricultural Institution, wherever established. The finest Agricultural School in Europe, is the "Konigl. Lehranstalt für Land u. Forstwirthschaft"—*Royal Institution for Agriculture and Forestry*—at Hohenheim, in the kingdom of Wurtemberg, in which these closely allied courses of training are brought under a single organization.

PREPARATORY COURSE.

Mathematics.—Arithmetic; Elementary Algebra; Geometry; Elements of Trigonometry.

Experimental Science.—Elements of Physics and Chemistry.

Descriptive Science.—Geography; Political History; Natural History.

Literature.—The vernacular Language,—including Grammar and, to a certain extent, Style in Composition.

Graphic Arts.—Writing; Drawing—to a greater or less extent.

The course here given, while more extended in physical science than that prescribed at the École Centrale, is very far inferior to that required at the École Polytechnique in mathematical science.* It more nearly represents the matriculation requirements of the German Institutions. But it will be observed that the latter frequently unite in the same general organization a Preparatory School, located in the same or separate buildings; and in such cases, the studies included in the preparatory courses are even more extended—at least in variety of subjects;† in fact, they present specimens of means well adapted to secure an *effective disciplinary training* preparatory to matriculation,—a desideratum of the utmost importance, in view of the fact that the subsequent courses of a Polytechnic Institute are of a nature to tax more or less completely the intellectual powers of any student.‡ As respects age, it is observable that students are rarely matriculated before sixteen; while, in general, they are from seventeen to nineteen years of age,—sometimes older than the latter limit,—before entering upon the regular course of a Polytechnic Institution.

GENERAL COURSE.

Mathematics.—Social Arithmetic; Higher Algebra; Analytical Trigonometry; Analytical Geometry; Differential and Integral Calculus.

Natural History and Geology.—Botany: Zoölogy; Mineralogy; Geology; Physical Geography.

Physics and Mechanics.—General Physics; Theoretical and Practical Mechanics.

Chemistry.—Theoretical and Practical Chemistry.

Literature.—Composition and Criticism in the vernacular language; Modern Languages.

---

* The knowledge required for admission to the École Polytechnique comprises:

1. Arithmetic.
2. Elementary Geometry.
3. Algebra.
4. Plane and Spherical Trigonometry.
5. Analytical Geometry.
6. Descriptive Geometry.
7. Mechanics.
8. Physics.
9. Chemistry.
10. Cosmography.
11. French Language.
12. German Language.
13. Drawing;—Geometrical,—Water Color,—Crayon.

"*Programme des connaissances exigeés pour l' admission à l' Ecole Impériale Polytechnique*,—Ministère de la Guerre,—*Paris*,—1854.

† See under *Bavaria*, p. 22.

‡ That is, provided, always, the course as such be actually accomplished.

PHILOSOPHY.—Logic; Ethics; Æsthetics; Jurisprudence.

GEODETIC ARTS.—Lower Geodesy.

GRAPHIC ARTS.—Descriptive Geometry; Geometrical Drawing; Topographical Drawing; Free Drawing.

PLASTIC ARTS.—Modelling in Clay, Plaster, etc.

TECHNICAL COURSES.

GENERAL CONSTRUCTIONS.—Materials used in Construction; Stabillty of Architectural and Engineering Structures.

MACHINES.—Theory of Machines; Transformations of Motion; Construction of Machines; Prime Movers.

SPECIAL ENGINEERING CONSTRUCTIONS.—Roads and Railways; Bridges; Hydraulic Works; Machines used in Construction; Location and Surveying of Works; Designs and Estimates.

SPECIAL ARCHITECTURAL CONSTRUCTIONS.—Components of Edifices; Architectural Design; History of Architecture; Architectural Decoration; Construction of Public and Private Edifices; Designs and Estimates.

GENERAL GEODESY.—Practical Astronomy; Higher Geodesy; Topogaphical Surveying.

INDUSTRIAL CHEMISTRY AND PHYSICS.—Technology; Technical Physics; Warming and Ventilating of Buildings; Technical Chemistry; Designs for Works and Processes.

METALLURGY.—Analytical Chemistry; Assaying; General Metallurgy; Designs for Works and Processes.

MINING.—Mining Geology; Mine Surveying; Mining Machines; Working of Mines; Mining Economy; Mining Jurisprudence.

GRAPHIC ARTS.—Free Drawing; Architectural Drawing; Machine Drawing; Topographical Drawing; Mine Drawing.

PLASTIC ARTS.—Modelling in Clay, Plaster, Wood, and Stone; Stone Cutting; Embossing.

The division of the Curriculum into general and technical courses is one rather of convenience than of fact, since there is scarcely a well marked instance of such a distinction to be seen in any one of the examples considered.* Our object in here recognizing the division named is, that we may indicate more precisely the subjects of study under their respective heads. The idea of a General Course is that of a *common basis* of all the specialties destined to follow—that is, of all the technical courses.

In respect to the General Course, it will be observed that the subjects included in our list, are common to almost every institution brought under our cognizance. The subjects thus named, although somewhat variable as regards extent of individual development in different institutions, may be considered to represent the *fundamental scientific and literary culture*,

* The organizations of the Berlin and Carlsruhe Institutions approximate to this condition, but are not strictly in accordance with it. Perhaps the closest approach is seen in the relations between the Polytechnic and Special Government Schools of France,—where the former becomes the General School in respect to all of the graduates who finish their educational courses in the Special Schools.

which experience has suggested to be appropriate to the objects of this class of educational institutions.*

It would be equally, nay more, difficult to generalize the distinctions observed in some of these institutions in respect to individual technical courses. Not intrinsically; but in having due reference to the facts as actually presented in the several cases. These are, first, in the absence, as already remarked, of the distinction of any really general or fundamental course; and secondly, in the diversity exhibited in the special courses. In certain cases, without doubt, this diversity has arisen in somewhat different local wants; in others it would be difficult of explanation except on grounds of merely arbitrary or at best temporary expediency. We have therefore been content to generalize the studies of the Technical Courses, as a whole, in accordance with the objects already stated, deeming this to be sufficient for our present purpose.

Methods.

That which has been already presented under the two preceding heads, is perhaps suggestive of all that need be said under the present one. We will merely add a single observation. It should be noticed that, in connection with the large amount of technical study which enters into the Curriculum of a Polytechnic Institute, there is associated the feature of nearly continuous daily practice in some kind of *sensuous* discipline—discipline of the senses. Each student undergoes an almost daily drill in a class of exercises which, besides tending to secure a high degree of muscular training, in all that belongs to facility and precision of manipulation, are of a nature, by their direct appeal to the senses, to contribute to a largely increased command of sensuous power,—in quickness and accuracy of sight,—in delicacy of touch, etc.. For example, in descriptive science,—botany, zoölogy, mineralogy, geology, etc., — we have practice in the study and direct examination of hand specimens of minerals, plants, and animals, with excursions to localities; in experimental science, physical and chemical manipulations in the laboratory; in the geodetic arts, the use of instruments in the actual conduct of astronomical, trigonometrical, and topographical observations of practical data; in the graphic arts, practice to a large extent in free, topographical, and geometrical drawing; in the plastic arts, modelling in clay, plaster, and wood, and stone-cutting, etc. Moreover, this peculiar discipline is carried out so extendedly in each of

* We have omitted to include *Religion* in the general course, first, because it occurs in only two or three instances; and secondly, in view of the more than doubtful expediency of placing religious culture—how all important soever in itself—in the Curriculum of such an institution.

the several examples noticed, as to secure to the diligent and attentive student an intelligent and complete command of the various practical operations which, in after life, would be likely to make direct requisitions upon this kind of knowledge.*

Educational Grade.

In addition to the several characters already noticed, the question may arise as to the *status* or educational grade of the Polytechnic Institute among its various cotemporaries in other fields of learning. In answer to this question it may be remarked, in the first place, that general usage on the continent of Europe appears to assign the Higher Technical Institutions a place among Universities in the "Superior System of Instruction."—Thus Dr. Schödler, in the course of an analysis of relative characteristics, exhibits the following parallel between the two systems of Humanistic and Technical Education:†

Humanistic Schools.		Technical Schools.	
Three-fold system.	Four-fold system.	Three-fold system.	Four-fold system.
1. Elementary School.	1. Elementary School.	1. Elementary School.	1. Elementary School.
	2. Gymnasium.		2. Real School.
2. Gymnasium.	3. Lyceum.	2. Techn. Middle School.	3. Higher Trade School.
3. University.	4. University.	3. Techn. High School.‡	4. Techn. High School.

In a similar manner, Prof. Bache, in recognition of this usage, places the Polytechnic and Special Technical Schools of the continent of Europe with the Universities in the system of "Superior Instruction," thus distinguishing this class of institutions from those devoted to "Secondary Instruction,"—such as the Gymnasia, Lyceums, Real Schools, Trade Schools, etc.§ So Prof. Playfair, more recently, while ranking the higher Technical Institutions with the Universities, speaks of the former as *Industrial Universities.*‖ Indeed, so far as we are aware there is no question as respects intelligent usage on this point.

But it may be remarked, that apart from the question of the fact, there are manifest reasons why such a usage should obtain. And these rest on the reality of the possession by each—by the Humanistic and Technical

* Of course, the observations contained in this paragraph, like preceding ones, are to be understood as *generalizations* of features of Polytechnic Institutions, as a class, rather than as strictly applicable to any single institution.

† "*Die höheren technischen Schulen nach ihrer Idee und Bedeutung.*"

‡ Generic or synonymic for Polytechnic School, Institute, etc.

§ "*Report on Education in Europe to the Trustees of Girard College for Orphans.*"—*Philadelphia,*—1839.

‖ "*Industrial Instruction on the Continent,*"—*London,*—1852.

University—of all those characteristics in common which are deemed more or less essential to the University idea; such, for example, as considerable maturity of age and preparation before matriculation,—the elevated nature of the prominent studies,—the predominance of the lecture mode of com municating instruction,—the aggregation of two or more professional schools,—the conferring of certain degrees,*—etc.

A true idea of the Polytechnic Institute is, therefore, that of a *series of Special Schools* for the complete educational training of Architects, Civil Engineers, Mining Engineers, and other Scientific Technists,—all united under a common organization,—all alike aiming at the realization not only of exact and extended scientific culture, but of the utmost practical skill in the applications of science to the pursuits of active life. The name Polytechnic Institute—Institute of many Arts—becomes etymologically significant when thus applied,—alike of the plurality, the nature, and the importance of its objects.† It is also manifest that the subjects and methods of study here noticed present an array of means well chosen towards the attaining of results so important; for, besides the extensive system of disciplinary exercises for muscular and sensuous culture, if it be remembered that the various theoretical and technical courses, in addition to the large amount of positive knowledge which they are designed to convey to the student, are adapted to secure a discipline of the intellectual powers of a high order of excellence,—it may be seen how a judicious combination of these two parallel but intimately connected systems of culture might conduce to the exaltation of the intelligence and executive

---

* The conferring of degrees is, perhaps, scarcely to be included among the actual features of the Technical Institutions, either of France or Germany. Even to be graduated at the École Polytechnique,—a distinction, unquestionably, very high of its kind,—gives to the recipient of this honor the right to style himself nothing more than "*Ancien Eléve* de l' Ecole Polytechnique"—*Former Student* of the Polytechnic School.

† Hence the School of Roads and Bridges at Paris, and the Mining Academy at Freiberg, although Special Schools of a high order, are yet not properly entitled to the epithet *Polytechnic*. The most *complete*—though not necessarily the best—Polytechnic Institution of those noticed in our sketch, is the "Polytechnic School" at Carlsruhe; next to this we might perhaps place the "Central School" at Paris and the "Technical Institute" at Berlin. The Polytechnic School of France, *in connection with* the various Special Schools of Application, may thus be considered a Polytechnic Institute of a high order.

In a similar manner we use the term *Institute* in association with its descriptive epithet, for the aggregation of several specialties under one general organization, in accordance with what we conceive to be the better German usage, in preference either to the word School or College,—the latter of which being in fact only a more ambitious as well as more ambiguous name for the same thing.—thus leaving the word *School* very appropriately applicable to the separate specialties,—in fact to every organization, which, besides being more simple, is characterized by unity rather than plurality of objects. In this sense the Polytechnic School of France and the School of Roads and Bridges, etc., are very properly called Schools,—although the propriety of the prefix Polytechnic in the former case is somewhat questionable.

power of the student and future practical man, up to the utmost perfection of development, of which merely secular education would appear to be capable.

Such, at least, as suggested rather than described in the preceding paragraphs, embraces our idea of the true Polytechnic Institute. Such we believe to be the legitimate tendencies of an efficient practical carrying out of this system of educational culture. It may claim more of results than can be said of any single institution among those which have come under our notice; it may be more than is practicable of realization, between unlimited imaginings and limited possibilities; but no more, than, as an idealization predicated of the results of our study of the characteristics of plan and working of these institutions, we should feel warranted to adopt as our embodiment of the true idea of the Polytechnic Institute, —towards the attainment of which we might always be permitted to make progress.

With this notice of the Scientific and Technical Institutions of Europe, we shall resume our consideration of the present condition and of the plans proposed for the future permanent establishment of the Institute.

EDUCATIONAL SYSTEM

OF THE

RENSSELAER POLYTECHNIC INSTITUTE.

The educational objects of the Rensselaer Polytechnic Institute, resulting from its reörganization of 1850, having been already stated,* we will now proceed to illustrate the characteristics of its educational system.

As at present constituted the Institute system embraces a Training or Preparatory School, and the Polytechnic Institute proper. The former is but a recent development of a "Preparatory Class" which has existed for several years, as a department of reception and preparation of those students—candidates for matriculation—who came unfitted to meet the matriculation requirements of the Institute. The course of study of the Training School is seen in the following programme.†

INSTITUTE TRAINING SCHOOL.

ELEMENTARY CLASS.

1. Religion.—Bible History and Biography.
2. English.—Orthography; Etymology; Reading.
3. Arithmetic.—Fundamental—Oral and Written.
4. Geography.—Introductory Geography.
5. Writing.—Copying from slips.
6. Drawing.—Linear Drawing from simple Maps and Patterns in Flat.

---

* *See pp.* 4 *and* 7. "The Rensselaer Polytechnic Institute shall have for its primary objects, the Scientific and Professional Education of Architects, and Civil, Mining, and Topographical Engineers."

"It is also declared that the Institute shall have for a secondary object, The Educational Training, in a general or partial course of Theoretical and Practical Science of all those who may resort to it for such a purpose."

—Institute Statutes.—*Annual Register for* 1855.

† The Training School was opened in the Building of the Troy Academy on the 24th October, 1855, through the coöperation of the Trustees of the latter. By an arrangement with them, the Trustees of the Institute have fitted up the Rooms of the Academy Building in a manner to answer quite conveniently the present wants of this School.

GENERAL CLASSES.

[*Course three years.*]

1. Religion.—Holy Scriptures;—Sacred History; Christian Morals.

2. English Language.—Composition;—Grammatical and Rhetorical Criticism.

3. Ancient and Modern Languages.—Latin Language; Greek Language; French Language; German Language.

4. Mathematics.—Arithmetic; Elementary Algebra; Elements of Synthetic Geometry.

5. Descriptive Science.—Geography; Elements of—Political and Physical; Political History; Natural History;—Elements of,—Plants,—Animals,—Minerals; Elements of Human Physiology and Hygiene.

6. Experimental Science.—Physics,—Study of selected subjects; Chemistry,—Study of selected subjects.

7. Vocal Arts.—Voice Culture; Elocution; Reading and Declamation; Vocal Music.

8. Graphic Arts.—Writing; Drawing from Geographical Maps; Free Drawing from Patterns in the Flat and Models; Geometrical Drawing.

9. Gymnastic Arts.—General Gymnastics.

SPECIAL CLASS.

[*Course one year.*]

MATHEMATICAL SECTION.

1. English Language.—English Composition;—Practical Exercises; Taking notes and writing out of Lectures; Grammatical and Rhetorical Criticism.

2. French Language.

3. Mathematics.—Higher Arithmetic; Algebra; Synthetic Geometry; Elementary Trigonometry; Logarithmic Arithmetic.

4. Experimental Physics.—Molecular and Gravitative Forces: Elements of Thermotics.

5. Natural History.—Elements of Botany, Zoölogy, and Mineralogy.

6. Vocal Arts.—Practical Elocution.

7. Graphic Arts.—Calligraphy; Free Drawing,—from the Flat and the Round; Geometrical Drawing,—Geometrical Problems.

8. Gymnastic Arts.

CLASSICAL SECTION.*

1. English Language.—English Composition;—Practical Exercises; Grammatical and Rhetorical Criticism.

2. Classical Languages.—Latin Language; Greek Language.

3. Mathematics.—Higher Arithmetic; Algebra.

4. Geography.—Ancient and Modern.

5. Vocal Arts.—Practical Elocution.

6. Graphic Arts.—Calligraphy; Free Drawing,—from the Flat and the Round.

7. Gymnastic Arts.

---

* The Classical Section is supposed to have for its immediate object the preparation of its members for the Freshman Class of a Classical College, and the course is constructed in accordance with such an object,—being a continuation mainly of the classical course of the General Classes.

The Training School, as its name suggests, is designed to present a system of disciplinary training essentially preparatory to a future course in the Polytechnic Institute. Its system of instruction is, however, intended to be such as to adapt it to fulfill equally well the functions of a Training School for the preparation of those destined to any of the Classical Colleges, without in any wise impairing its capacities for usefulness in respect to its primary objects. The three "General Classes,"—Lower, Middle, and Upper,—have a systematic course of three years. This course,—which is the same for all, whether preparing for the Institute or a Classical College,—is constructed with a view of securing a well balanced and effective training in physical, intellectual, and moral discipline, as also an amount of positive knowledge appropriate to the general objects of the School. The "Special Class" includes two Sections,—a Mathematical and Classical. The course is arranged for one year, and in logical succession is intended to follow the course of the General Classes. While, therefore, the latter course is designed to be a common basis in literary, scientific, and art culture, the former is intended to realize certain special extensions of the Mathematics and Classical Languages. The course for each class of students resorting to this School—Mathematical and Classical—will thus be four years in duration. For admission to the "Lower Class" of the Training School an age of at least twelve years is required and a certain preparation in Reading, Writing, and Arithmetic. Younger pupils are received into the "Elementary Class" from ten to twelve years of age, in which they receive a preparation for entering the Lower Class. Admission into any of the Classes,—the Lower to the Special, inclusive,—is permitted in all cases where the applicant is properly qualified in age and scholastic attainments.

The course for matriculation in the Institute is indicated in the programme of the Mathematical Section of the Special Class. Students who are at least sixteen years of age and otherwise properly prepared, are admitted to the Special Class, without the necessity of going through the previous course of the General Classes, and are thus enabled to complete their preparation for entering the lowest class—*Division C*—of the Institute, within the scholastic year.

The Institute Curriculum is seen in the following programme of the courses of the General and Technical Schools.

RENSSELAER POLYTECHNIC INSTITUTE.

[*Course three years.*]

GENERAL SCHOOL.

1. Mathematics—Higher Algebra; Analytical Trigonometry; Analytical Geometry Differential and Integral Calculus.

2. Mechanics.—Rational [Pure] Mechanics of Solids, Liquids, and Gases.

3. Physics.—Magnetism and Electricity; Acoustics and Optics.

4. Chemistry.—General Chemistry of Inorganic and Organic Bodies; Practical Chemistry,—Manipulations.

5. Natural History.—Botany; Zoölogy.

6. Geology.—Mineralogy; Geology.

7. Cosmography.—General Cosmography; Physical Geography.

8. Literature.—English Composition, Elocution, and Criticism; French Language; German Language.

9. Philosophy.*—Intellectual Philosophy; Ethics; Æsthetics; History of Philosophy.

10. Geodetic Arts.—Line Surveying; Practical Trigonometry; Topographical Surveying; Hydrographical Surveying.

11. Graphic Arts.—Descriptive Geometry,—General Problems,—Shades, Shadows, and Linear Perspective; Geometrical Drawing; Topographical Drawing; Free Drawing.*

12. Plastic Arts.*—Modelling in Clay and Plaster.

13. Gymnastic Arts.*—General Gymnastics; Fencing and Sword Exercise.

TECHNICAL SCHOOLS.

GENERAL STUDIES.

Practical Mechanics.
Construction Drawing.
Machine Drawing.
Topographical Drawing.
Engineering Geodesy.
Metrical Arithmetic.
Practical Geology.
Practical Mineralogy.
Architectural Design.*
Free Drawing and Modelling.*
Æsthetics of Constructive and Ornamental Art.*
Graphics of Carpentry and Stone Cutting.
Industrial Physics.
General Constructions.
Theory of Machines.
Transformations of Motion.
Prime Movers.
Construction of Machines.
Jurisprudence.*
History of Architecture.*
Landscape Gardening.*
Ornamental Drawing.*

SPECIAL STUDIES.

I.—School of Civil Architects.*

Construction of Public and Private Edifices.
Architectural Decoration.
Modelling of Architectural Constructions.
Architectural Drawing.
Lighting, Heating, and Warming Buildings.
Designs and Estimates for Architectural Constructions.

II.—School of Civil Engineers.

Special Constructions;—Hydraulic Works; Bridges; Tunnels; Common Roads and Railways.
Road and Railway Traction;—Forces,—Machines.
Railway Economy.
Modelling of Engineering Structures.*
Practical Astronomy.
Higher Geodesy.
Road and Railway Surveying and Mensuration.
Road and Railway Plans and Sections.
Designs and Estimates for Engineering Constructions.

---

*Subjects and courses which are not, as yet, actually introduced into the working exercises of the Institute Curriculum.

III.—School of Mining Engineers.*

Mine Surveying.	Analytical Chemistry.
Mine Drawing and Modelling.	Practical Assaying.
Mining Geology.	General Metallurgy.
Mining Machinery.	Special Metallurgy of Iron.
Mine Working.	Construction of Smelting Works.
Mining Economy.	Designs and Estimates.

Observations on the Institute Curriculum.

We have already given the Matriculation, General, and Technical Courses of our *representative* Curriculum of a European Polytechnic Institution, in illustration of this very important feature of the true idea of such an institution. It would naturally, therefore, be a matter of some interest and, indeed, of some importance to establish a comparison between the Institute Curriculum of the preceding pages and this typical one of its European cotemporaries, since it might thus be possible to obtain an intelligent view of the excellences not less than the deficiencies of the Institute System as tested by such a standard.

But a comparison of the educational systems of two or more institutions is not likely to be a very satisfactory performance, if the data constituting the basis of the comparison consist only of mere programmes of the subjects studied; since, a collocation of titles however captivating for its completeness and symmetry,—*as displayed upon paper*,—may be quite another thing as actually carried out in educational practice. The *extent* to which the several subjects are respectively studied,—the *manner* in which they are studied,—the *tone of the examination standards*, which ultimately decides all questions of qualification in the same studies,—are circumstances very essential to the formation of a satisfactory judgment in matters of this kind.

It is not always practicable to obtain full information on these several points in respect to the European Institutions. Still, by means of official and other publications which sometimes give the subjects *in detail* of the courses of study, and by the aid, occasionally, of manuals or treatises on certain subjects of the courses, prepared by professors in these institutions, we are enabled, in the majority of cases, to come to tolerably satisfactory conclusions with respect to the extent, as well as to the efficiency with which the courses are actually carried out. As regards the Institute, it is proper to remark, that the authorized published statements of its *Annual Registers* give not only its courses of study in sufficient detail to indicate with considerable definiteness the extent to which the different subjects are respectively developed, but they also contain explanations of the mode of study and of examination standards sufficiently full and explicit, we believe,—with certain exceptions to be presently noticed,—to satisfy any

reasonable inquiries under this head. To these publications we must refer for such details. Our limits will merely permit us to indicate in a brief running review, the more prominent resemblances and differences in order that we may be able to note those deficiencies which still exist in the practical carrying out of the Institute Curriculum.

The General School.—Passing over the course required preparatory to Matriculation, and we come to the regular courses of the Institute which are included in the General and Technical Schools. The idea of the former is that of a system of *general disciplinary culture*,—scientific, literary, philosophic, artistic,—prior to entrance upon the study of any form of *applied science or art.* An aim in this School is to preserve the distinction between what is theoretical and general and that which is more or less practical and special. The course of the General School, as will be seen, is nearly identical with the "General Course" of the typical Curriculum previously given. With the exception of certain subjects under Literature and Philosophy, as also of Free Drawing and Modelling, the various parts of this course have, within the past few years, received a practical development, as regards extent and thoroughness of study which, it is believed, will compare quite favorably with that generally achieved at similar European Institutions, with the exception of the École Polytechnique. Of the exceptions it may be remarked that, in respect to a part,—Literature and Philosophy,—provisions for regular instruction have been made, but the pressure of the more essential parts of the course, has hitherto prevented the realization of anything more than a partial —not proportional—development of these subjects. Free Drawing and Modelling have lacked attention mainly for want of suitable rooms and collections. Indeed, while the general graphic course of the Institute has received a very satisfactory development in most respects, free drawing, properly so called, has had scarcely a beginning. There is no want of appreciation of the importance both of free drawing and modelling, and it is only hoped that it may be practicable at an early day to secure to both that attention which, with their place in the Institute System, they properly demand. And of Gymnastics it may be remarked that, with the absence of the requisites for a systematic and efficient conduct of this course,—a proper building and apparatus,—it has been deemed advisable to defer it to a more propitious time.

The Technical Schools.—The Technical Schools embrace General and Special Studies, the former comprising those studies common to all members of the class,—the latter including certain extensions in the specialties of the several Professional Sections. The General Studies have already received a very good development, which is also true of the specialty of

Civil Engineering,—the latter including Topographical* and Mechanical Engineering. But, although the foundation is well laid in the course of the General School and General Studies of the Technical Schools for the specialties of Architecture and Mining Engineering, still the special teachings under these respective heads yet remain to be brought into working action. As remarked in another place, the aim in carrying out the plans embraced in the reörganization of 1850, was to establish a foundation broad and deep of the educational system, and develop just so much of technical study as should be found practicable with the means at command. Of the Technical Courses generally, so far as actually carried out at the Institute, it is believed that, with few exceptions, they will compare favorably with those of the majority of similar European Institutions. The exceptions have reference in general to those subjects whose best elucidation demands those essential aids which are only to be had in extensive collections of models and other similar scientific and technical apparatus.

As respects the general idea of the Institute System, we deem it proper to remark, and at the same time avoid unnecessary repetition, that the observations which were made in connection with the generalizations of a former part of this paper, represent the views as they also illustrate the spirit of the present Institute management in all that belongs either to the work actually being done, or to the hoped for consummation of plans of future development.†

Plans of Future Development.

Under this head we propose to indicate very briefly such improvements of, and additions to the educational system of the Institute as seem to be not only practicable and expedient, but urgently demanded by the best interests of the Institution,—which are identical with whatever is in the highest degree useful to those who may wish to avail themselves of its educational resources.

There can be no question in the mind of an intelligent observer, of the great and pressing need of educational facilities for the proper study of Mining Engineering,—including all that belongs to each of the specialties of Mining and Metallurgy. With a country of immense magnitude, and possessed of mineral resources,—so far as actually ascertained—to say

---

* Experience has shown the practical inexpediency of making a specialty of Topographical Engineering, distinct from that of Civil Engineering; and, accordingly, the slight extension of studies appropriate to the former may be properly merged in the general course for Civil Engineers.

† See pages 31—39. Also,

"*Design of the Institute System,*"—and "*Institute Statutes,*"—*Annual Register for* 1855.

nothing of what is unknown—as remarkable for variety in kind and generality of distribution, as they are astonishing for abundance, we have, as yet, not a single organized School of Mining Engineers in the United States, nor, indeed, upon the American Continent! Either our people have found out the secret, hitherto and elsewhere undiscovered, of dispensing with the aids supplied by the resources of Science and of Technics constructed upon the basis of Science, or they have, while conscious of their needs in these respects, been compelled to struggle on, and by their enterprise, activity, and other native resources, make up in this way as best they might for their acknowledged deficiencies in the other direction. Whether the former or the latter of these two alternatives be the more reasonable can scarcely be long a matter of doubt among persons of competent intelligence, if they will but glance at our previous sketches of the principal Technical Institutions of Europe, where it will be seen that instruction in Mining and Metallurgy constitutes a part of the programme of nearly every Polytechnic Institution,—observing that, in addition, there are numerous special Schools of Mines in England, France, and various parts of Germany. But so far as we are aware there is no doubt on this subject. The want of well educated Superintendents of Mines and Metallurgic Works has been too frequently indicated by those most immediately and deeply interested, to leave room for doubt either as to the urgency of the need of such institutions or of the appreciation which would be sure to greet their appropriate establishment.

If, for the sake of illustration, we refer to the programme of the Royal Mining Academy of Saxony, it will be seen that the great body of the instruction as there presented, is such as enters into the general courses, theoretical and technical, of nearly all Polytechnic Institutions,—the *special teachings*, which relate to the practical conduct of mining and metallurgic operations, alone, being in any respect, peculiar to the institution. Hence, in order to establish such a department at the Institute, one or two additional instructors entirely competent in the departments of Practical Mining and Practical Metallurgy would, so far as additions to the corps of professors is concerned, be entirely sufficient. But in the utter absence of this kind of learning on our side of the Atlantic, we must be content to draw from the stores of European experience; and, accordingly, the idea here alluded to of *competency* of Instructors in these departments, must be understood to involve not only entire familiarity with the methods of instruction in the best European Institutions, but a certain amount of successful experience in the actual conduct of mining and metallurgic operations in those countries. With such an addition,—together with the concurrent ones of suitable buildings and of the necessary scientific and technical collec-

tions,—the Institute would be able to put into very speedy action a train of educational means as well adapted to the achievement of useful results in Mining and Metallurgy, as has been already conceded to it in respect to its present specialty of Civil Engineering.

A condition quite as anomalous exists in respect to Schools of Architecture. While such Schools are to be found in association with the objects of almost every Polytechnic Institution on the Continent of Europe, there is not, so far as the writer is aware, a single example of such a School in the United States. Surely if there be reason for the frequent occurrence of these Schools abroad there must be some reason for, at the least, a single one in the new world. Unless we much mistake the meaning of those indications which are daily multiplying around us, our people, with their growing appreciation of the beautiful and the truthful, will not long be satisfied with the continued iteration of the sorry results of mere empiricism in this important department of constructive art.* Taste long outraged, not less than endangered securities of life and limb, will unitedly cry out for something better,—more beautiful—more appropriate—more truthful—more stable. There will, by and by, be Schools of Architectural Art in this country. Why, then, with the eminent fitness of the association,—justified by congruity of teachings and objects, and confirmed by long usage in the institutions of the old World,—why should we not carry out the Institute designs in the establishment of a School of Architecture worthy of the name? Similar remarks are applicable here to those adduced when speaking of the provisions required for putting into action a School of Mining Engineers. Only in this case less costly means would be sufficient. With the foundation courses already established,—with the aid of the general courses in free drawing and modelling, which should be brought into action for general needs at the earliest possible day,—there would be required the services of scarcely more—in equivalency—than one full additional professor. But in this, as in the other case, there must be suitable buildings and collections, more or less costly, in order to the successful realization of such an addition to the Institute capacities for public service.

We have long cherished the hope that a system of facilities might ultimately be built up within the Institute organization for the general cultivation of the Arts of Design in connection with their various industrial applications. Institutions having such an object in view, although rarely

---

* Of course, we do not mean to intimate that there are none but empiricists in Architectural Art in this country. We are speaking of things too *generally* true to admit, we believe, of much question.

seen in this country,* are of frequent occurrence in Europe, under the name of Schools of Design, or sometimes,—and perhaps quite as appropriately,—Schools of Ornamental Art. Such a School usually includes a two-fold system of culture: first, the study of *general drawing and modelling*, as a Fine or Pure Art; secondly, the study of *applied* or *technical drawing and modelling*, as Ornamental Art. The organization which results from such a system is naturally, therefore, a compound one,—that of a School of General Design [School of Pure Art] and Schools of Technical or Industrial Design [Schools of Ornamental Art]; the former standing in the relation of a school of theoretical and fundamental training with respect to the latter.

As an illustration of the objects and methods of a School of Design, we present the following *generalized* statement of the subjects of study of the better class of these Schools.

I.—SCHOOL OF PURE ART.

1. Geometrical Drawing,—including Shades, Shadows, and Perspective.
2. Free Drawing,—including Crayon and Water Color, and Painting in Oil.
3. Modelling.
4. Artistic Anatomy.
5. Æsthetics and History of Art.

The studies in drawing and modelling, after a little preliminary practice in drawing from patterns, are immediately directed to drawing and modelling *from the round*,—the subjects including not only models of geometrical forms, casts and living specimens of plants and animals, but the figure — from the antique, the lay, and the life.

The object of the School of Pure Art, is to furnish a thorough training of the *eye* and *hand*, in connection with the cultivation of the taste and inculcation of the principles of æsthetic criticism. As such, it properly precedes all special application. The subjects of study appropriate to the Schools of Application are seen in the following programme.

II.—SCHOOLS OF ORNAMENTAL ART.

1. Engraving on Wood.—Lithography.

---

* "Schools of Design" have been established in New York, Philadelphia, and Boston,—some three or four in all,—within the past four or five years. These Schools are, we believe, mainly eleemosynary in their objects, by proposing to women certain facilities for instruction in drawing and engraving, at nearly nominal charges, in order to open up to them a sphere of future employment, which, besides being far more remunerative, should be more worthy of their mental and physical capacities than those precarious, severe, and ill paid labors, to which many of the sex are otherwise doomed in our larger towns. Although these Schools have already achieved highly useful results in justification of the primary intentions of their kind-hearted founders and patrons, still, as Schools of Art, these institutions are, as yet, too limited and partial in scope, to be regarded as *Schools of Design* in the same sense in which we speak of their European cotemporaries.

2. Foundry Work.—Designs for work in Cast Iron, — Stoves, Chimney Pieces Railings, Furniture, etc.; Designs for work in Zinc and Bronze.

3. Metal Work.—Designs for work in Gold, Silver, Zinc, etc. — Electro-plated and Electro-gilded work; Designs for work in Brass, Bronze, etc.—Lamps, Chandeliers, Gas Fixtures, etc.; Designs for work in Wrought Iron, — Railings, Fencing, etc.

4. Ceramic Arts and Glass Work.—Designs for Pottery and Porcelain, Terra Cotta, Tiling, etc.; Designs for Glass work.

5. Textile Fabrics.—Designs for Woven work,—Carpeting, Shawls, and figured stuffs, generally, in Wool, Silk, etc.

6. Surface Decoration.—Porcelain Painting; Designs for Floor Cloth, Paper Hanging, and Calico Printing; Designs for Printing on Lace and Muslin Tissues, etc.

7. Architectural Work. — Designs for Architectural Ornament, Ceiling and Mural Decoration, Furniture, Upholstery, etc.

The above, although by no means complete, will, perhaps, suggest an idea of the immense field of service thus provided for the legitimate exercise of the skill of the Industrial Designer. And is there any question of the importance of this kind of knowledge to the successful prosecution of the various Arts indicated in the preceding list? Among intelligent manufacturers can there be many found who have failed to appreciate, sooner or later, their wants in this respect? We believe not. And, if, by force of circumstances, there are manufacturers who have hitherto done without these aids, until they have come — in unconscious ignorance — to cast contempt upon the labors of Artists in their behalf, we believe that "Universal Exhibitions" are likely to prove a salutary corrective. Great Britain, although in some cases availing herself largely of the labors of foreign Designers, and in certain others, with questionable propriety, *appropriating* rather than applying the Arts of Design, had done comparatively little for Schools of Design, prior to 1851—the year of the London Exhibition. Her manufacturers had been sufficiently aware of the existence of Schools of Design on the Continent of Europe for years before; they had frequently employed graduates of these schools in their own works; they had quite too frequently not only appropriated, but even mal-appropriated,—a doubly grievous wrong,—in the absence of cultivated taste and skill, the designs of their continental neighbors, sometimes confounding all distinction between those for figure weaving, surface decoration, and ornament in relief; but they failed to perceive the utility of Schools of Design *among themselves* until a more tangible argument came up, and this an appeal not so much to their appreciation of the beautiful, the appropriate, and the just, as to a more selfish interest: they were in danger of being supplanted by others, and these foreigners, in their own fields of industrial art. Such an argument was successful. Since 1851, these institutions have been so largely multiplied that there are now Schools of Design in every considerable town, in addition

to the metropolitan establishment at Marlborough House, which, with its princely collections, combines within itself the functions both of a Model School and a Training School of Teachers for the provincial schools.*

It has already been seen that instruction in Industrial Design enters into the system of almost every German Technical Institution, — higher and lower. Manifestly this is an appropriate association. For, in addition to Art culture, in drawing and modelling, the Industrial Artist should be acquainted, to a certain extent, with the principles of science and the processes of construction and fabrication; since every design, worthily so-called, should exhibit that fullness of study, in respect to knowledge of adaptation, which can only proceed from a proper consideration of the *material* in which—the *process* by which—the *use* for which—it is to be ultimately wrought out. Hence we believe in the expediency of connecting all special cultivation of the Arts of Design with Technical Institutions, in accordance with the German practice, rather than in leaving them, as in England, to be schools merely of drawing and modelling. Indeed, English experience has already begun to see the importance of associating instruction of a scientific and technical nature with their Schools of Ornamental Art.†

As regards the means for carrying out such a system of Art culture at the Institute, it may be remarked that, when the general courses of free drawing and modelling shall have been brought into working action, in accordance with original intentions, the course of study for a School of Pure Art will become virtually established; and there will remain for the complete development of the idea, the providing of instruction in Technical Design or Ornamental Art, in connection with the necessary rooms, collections, etc.

We have dwelt longer upon the last topic than may seem to be appropriate to our present object. But we believe the specialty of instruction in Industrial Design to be not only of vast importance to manufacturing industry, but to be quite essential to the harmonious development of the Institute System, since the kind of culture here described should enter more or less into all parts of it.

---

* *Lectures on the Results of the Exhibition,—London,*—1851.—*London Art Journal,—vols. for* 1851–2.—*Playfair,*—"*Industrial Instruction on the Continent.*"
We do not refer to Great Britain for an illustration of anything *peculiar* in this connection; we need not travel many miles from this city, nor, indeed, far from any manufacturing centre in this country, to find a state of things not *very* dissimilar to the kind of British experience above described.

† *London Art Journal,—vols. for* 1852–4.

We have hitherto made no allusion to the study of Technology* as a part of the Institute System. It is, however, proper to remark that, although the present Curriculum contains no provision for the study of this specialty, yet the idea of introducing such a department into the system of instruction has been frequently entertained. The idea was in fact considered at some length during the discussions attending the reörganization of 1850; it was, however, finally resolved that, as a matter of present expediency, it would be best to postpone for a time the actual introduction of these studies into the Institute System. More recently, the matter of Technological instruction was made the subject of a formal recommendation, in the Report of a Committee† on certain proposed improvements of the Institute,—their language in reference to which being as follows:—

"Of the utility of a School of Chemical Arts, it seems sufficient to allude to two significant facts; first, that the various Chemical Works of this country are almost invariably put in operation and managed by foreigners, who have received their education abroad; secondly, that with a country of resources confessedly large for carrying on these operations with pecuniary success, there are, nevertheless, no schools, as yet, established in the United States, which give the requisite scientific and practical training to *Manufacturing Chemists;* while it is certain that the provisions made at the Polytechnic or Industrial Schools of France and Germany, for the study of the construction and management of Chemical Works, constitute features in those institutions which are as conspicuous as they are practically efficient for the object proposed. Your Committe, therefore, in view of the importance of establishing such a School of Chemical Arts, earnestly recommend not only a full resident Professorship of General and Analytical Chemistry,‡ but also a Professorship of Chemical Technology, the appointment to the former to be immediately made, and to the latter as soon as the requisite general provisions can be secured."

The construction and management of Potteries, Porcelain and Glass Works,—Bleaching, Dyeing, and Printing Works,—Gas Works,—Chemical Works,—etc.,—are among the more prominent examples of the class of industrial operations, which an enlightened experience has generally committed to the professional direction of properly educated Technologists. Argument is unnecessary to show, that the most successful conduct of these enterprises can scarcely be expected, without a liberal supply, as well as an intelligent use, of the aids derived from a comprehensive system of scientific, technical, and artistic education. Indeed, wherever this matter

---

* We use the term—see notes page 32—as comprehensive of both Technical Chemistry and Technology, usually so called, the distinction between which being difficult in some cases of a clear definition. The distinction of *Chemical* and *Mechanical* Technology is recognized at certain European Institutions.

† Dr. T. W. Blatchford, Joseph M. Warren, and John A. Griswold,—*appointed by a public meeting of citizens of Troy,—January,* 1854.

‡ At that time, the Professorship of General and Analytical Chemistry was *temporarily vacant,*—it has since been supplied.

is best understood,—as in France and Germany,—the course of educational training for Technologists is nearly, and in some instances quite co-extensive with that for other classes of Technists.

Although we are fully persuaded that, in the order of progress, the specialties already mentioned should receive the first attention of the Institute management, we are, nevertheless, of the opinion that so soon as these can be brought into working action, the specialty of Technology should receive the attention which it properly deserves. And this, whenever done, will present little practical difficulty; since, as has been remarked of the specialties of Architecture and Mining Engineering, so it may be said of the one under consideration;—the greater part of the studies appropriate to the Technologist are already included in the Institute System; and, accordingly, in order to make this specialty a part of the System, it would only be required to provide the necessary *special teaching*, rooms, and collections.

In what has been already observed, under the head of Plans of Future Development, we have noticed those technical specialties, which, as crowning features of the Institute, should receive its earliest and most persistent attention, until they shall have reached that fullness and symmetry of proportions which have been assigned to these subjects in the Institute System. It will, however, be remembered that, in our observations on the Institute Curriculum, we alluded to several subjects which had been not at all, or at most but partially, brought into working action. Literature, Philosophy, Jurisprudence, Free Drawing and Modelling, and Gymnastics, were mentioned in this connection. Of Free Drawing and Modelling, nothing further need be said in addition to what has been already remarked under Schools of Design. Of Literature, we may remark that the study of *German* is at present crowded out of the course from the pressure of parts already in action; while the study of English Composition is but partially developed. The latter, however, including the subjects of Literary Taste, Study of Words, Style, and History of Literature, is soon to be brought into full practical action as a part of the Course.* The department of Philosophy is in a similar state of non-development, partly on account of the pressure of other subjects more immediately important, and, partly, from the absence of the necessary provisions for competent instruction in a part of the subjects embraced in this department. The department is a comprehensive one, and should, for practical convenience and efficiency, be resolved into the three specialties of Intellectual and Ethical Philosophy, Logic, and Æsthetics. While we confess to little appreciation of the

* A department, essentially, of *Rhetoric*, but somewhat more comprehensive in certain respects.

utility of spending much time in the study of *Deduction*, after the methods of the ancient or modern dialectics,—i.e. Syllogistic Logic,—we believe that the importance of the study of *Induction*—the Logic of Lord BACON—can scarcely be over-estimated, either as rational culture, or as a preparation of the man of the present day for the most useful career among his fellow men. It is especially important in connection with the studies of a Polytechnic Institution. Of Æsthetics, it need only be said that, with the materials for a rational philosophy of the Beautiful, it is manifestly important that these should be brought into a form to exert due influence in directing the tastes of those who are to have much to do with the business of *Design* in any of its manifold applications.* In respect to Jurisprudence, including, particularly, that which relates to Civil and Mining Engineering, it may be said, that there seems to be as much propriety—to say nothing more—in making such studies a part of the system of a Polytechnic Institution *in this country*, as in introducing them into the systems of similar institutions in the more or less despotic States of Germany. Similar remarks might be made in respect to Political Economy.

The question may be raised as to the utility of such studies as Rhetoric, Philosophy, etc., to the Architect, Engineer, and other Technists. It is a natural question, and one not unfrequently asked in these days, when the element of *time* which is spent in connection with education is estimated at so high a value. Experience has shown conclusively enough to all thoughtful observers that, in a course so largely—in its very necessities—*material*, as that which obtains in a Polytechnic Institution, there should be introduced compensating or balancing elements. And what studies so suitable as those which cause us to turn from the observation of *things* without, to the contemplation of the wonderful phenomena and resources within, the Human Mind? Apart from all consideration of the practical advantages which accrue even to the Technist,—and they are not only manifold in fact, but *ought to be obviously so* to all intelligent and discriminating observers,—from this class of studies, we repeat that, viewed as a mere *equipoise* to the study of the Mathematical, Physical, and Technical Sciences, we believe they should find a prominent place in the educational system of every Polytechnic Institution. Such appears to be the view taken of this matter in Germany; it is far less observable in connection with the Polytechnic Institutions of France.

---

* Instruction is already provided for, of a very competent kind, in the first of these divisions. Of Logic and Æsthetics, our convictions are that, in order to realize Institute needs in this direction, these subjects should be under the direction of *separate minds*,—of those, indeed, who, with appropriate organizations, have made these subjects matters of *special* study.

Finally, it may be said that, although the methods of the Institute afford considerable opportunity for physical exercise in connexion with the various field operations of Practical Geodesy, scientific excursions, etc., still this incidental advantage is far from being sufficient to take the place of a course of systematic Gymnastics, as means of rational physical culture. There is nothing more needed in these days of bodily insufficiency; and yet, with the existence of an evil so generally admitted, there are scarcely no educational appliances so rarely seen at our educational establishments. Even where "Gymnastics" constitutes a part of the programme of educational courses,—as it does in some of our Schools for Boys and Girls,—it embraces little else, in most cases, than a room or yard, provided with a few of the commoner forms of apparatus, to be used, *ad libitum*, by the pupils as a means of enlarging the area of their resources in physical exercise. This, even, is worth something, and we would not wish to estimate it below its just value. But Gymnastic training, worthily so-called, is a much more serious matter; for it implies an array of means for the complete and harmonious development of the whole muscular system—of the entire physical man; results which require a systematic disciplinary drill, under competent direction, of several years duration, regularly filling up certain hours of each week set apart for this kind of culture. The resources gained by such a system of culture are not alone of a physical kind; they are largely intellectual and moral. Presence of mind, consciousness of physical capacity, power of command, and promptness of action, in moments of critical and trying circumstances, as well as on ordinary occasions, are among the mental gains by such a culture. While desirable for all persons,—men and *women*,—such a training is especially called for in the education of professional Technists, who,—besides needing the physical powers and mental control conferred by such culture, for the most efficient conduct of professional duties as well as for self-preservation in times of personal danger,—are sometimes suddenly confronted by an array of circumstances, where the safety of the lives and limbs of hundreds of workmen and others may be, in a measure, dependant upon their possession of just such resources as those here described. Much might be said in respect to the favorable influence upon the general health of such culture; and very many reasons might be urged why it should form a parallel and *contemporaneous* system in all intellectual education of the youth of both sexes; but our limits are too restricted to permit further extension of this subject.

With the foregoing statements and illustrations, we trust that we have, at least, partially succeeded in realizing the purpose mainly contemplated in the preparation of this paper. We wished to make clearly apparent *what the Institute really is* as an educational establishment. On this point, as remarked in another place, considerable misapprehension has existed, and, we believe, still prevails in certain quarters. The Institute is, undoubtedly, quite extensively known as a School of Civil Engineers; there are some, however, who suppose it to be a School of Theoretical and Practical Science similar to the "Scientific Schools" which have been established in connection with several of our Classical Colleges within a few years past; and there are others, who, while assuming that the Institute may possibly serve a valuable purpose in the diffusion of certain useful kinds of knowledge, do not understand that it professes, or is at all adapted, to present any thing like a system of *general or liberal education*. These are selected as specimens only of views known to have been entertained on this subject. The first, under the circumstances which attend the partial development already noted, is, perhaps, nearly or practically correct; the others are founded in misconceptions of the objects and methods of the Institute System.

We affirm the truth of the following proposition,—that *the idea of the Polytechnic Institution, fully worked out, embraces an array of appliances adapted to the most complete realization of true educational culture.* We have no good reason for believing that man was intended to live the life of a monk in his cloister. To say nothing more, mediæval have changed to modern times; and, confessedly, without speculation on the much vexed question of what was, or can be, the era best suited to the display of man's varied powers, it is enough for our present purpose to know, beyond any doubt, that his truest interest not less than his highest duty consists with the most resolute adaptation of himself to the demands and circumstances of the age in which he lives,—that is, the *present* age. What, then, we beg to ask, is the kind of education which best comports with the idea of such an adaptation? Should not such an education aim at the development and cultivation, so far as may be practicable, of man's whole powers of perception, of thought, of feeling, of expression, of action?

As intimated in a preceding paragraph, the idea is not unfrequently entertained that, because the Institute is primarily designed for the education of Engineers and other professional Technists, its educational system must of necessity be partial and one-sided; that, because the Institute is neither in name nor in form a Classical "College," whatever be its excel-

lence in other respects, there must, forsooth, *inhere* the radical defect of incapacity to secure to its graduates that completeness of scholarly culture, which is comprehended in the idea of a "liberal education." Is the popular interpretation, as derived from the objects, organizations, and usages of old and honored Universities, essential to the idea of such an education? If so, how shall we select the epoch in the history of these institutions, in which to find the truest expression of educational standards? Must we, in deference to those who lament the decline of classical learning, visit the English University of the seventeenth century, when nearly all learning, with the exception of Theology, consisted in teachings or interpretations of Greek and Roman authors?* Or, shall we, in paying due attention to the views of those who are clamorous for the *maximum amount of study in a minimum time*, come down to the present period and take our standard from some of the American Colleges?

We are conscious of no ambition to run a tilt against Classical Institutions, feeling well enough assured that we should but shiver our lance in the attempt; and we have even less inclination for a task so ungracious to one having any real love of learning. We have too much reverence for those asylums of learning of the middle ages, which, in despite of political and religious convulsions the most dire, have been preserved to the present day, to join in a cry which is too often most loudly echoed by those who would practically sink all learning to the level of the merest empiricism. Our only object, indeed, in touching upon a theme so prolific of discussion, and withal so unsuited to the objects of this paper, is, that, while directing attention to the countless varieties of standard of University education,—not only as naturally due to chronological changes in the state of learning, but as scarcely less strikingly observable in contemporaneous institutions of the present time,—we may suggest the possibility of conceiving that the system of education more or less common to the Polytechnic Institutions of modern times, although materially different in kind, might, nevertheless, as a parallel system of educational culture, be little inferior —to say nothing more—to some of the former, leaving out of the estimate all comparison of relative adaptation to the business of life. And, in conclusion, in the absence of the opportunity for any attempt at analysis, we

---

* Or, a little earlier, when the Universities embraced a body of "Men of sharp and strong wits, and abundance of leisure, and small variety of reading, their wits being shut up in the cells of a few authors, chiefly Aristotle their dictator, as their persons were shut up in the cells of monasteries and colleges; and knowing little history, either of nature or time, did, out of no great quantity of matter, and infinite agitation of wit, spin * * * cobwebs of learning, admirable for the fineness of thread and work, but of no substance or profit."—Lord Bacon,—"*Advancement of Learning.*"

venture to propose an intelligent and careful perusal of the Institute Curriculum,—including also the typical one on a previous page,—as a complete answer to those who have doubts of the excellence and fullness of the educational discipline proposed to the Architect, Engineer, etc., in a well appointed Polytechnic Institution.

We are, however, profoundly conscious of present deficiencies in the Institute System as *actually carried out*;—but we are not less conscious of its present excellences;—and yet, notwithstanding these acknowledged defects, the Institute has made progress, in the appreciation of the public, not less steadily, we believe, than it in duty *ought* to make in the continuous improvement and development of its educational system. As a School of Civil Engineers, we feel free to say, with a frankness, we trust, not unbefitting official associations, that, although falling far short of our ideal of what this specialty of present development should be, we believe its characteristics of usefulness are such, even now, as to make it worthily entitled to the wide-spread and increasing patronage which it continues to receive. With the foundations of an educational system so substantial and well-tried,—with the super-structure of such a system already sufficiently developed to the light, how unfinished soever at present, to reveal to an observing and discriminating eye good promise of fair proportions in the future,—with its rapidly widening circle of appreciative patronage,—we can scarcely be said to be prompted by an unwarrantable enthusiasm in believing that a Polytechnic Institution of the highest order, might be, and should be, built up by effecting the complete development of the educational plans of the Institution in our midst.—But, in order to the practicable realization of such a development, there must be,—as already several times repeated, when describing its special features,—*suitable buildings, sufficient scientific and technical collections*, and the *requisite additions to the corps of instructors*. To the nature and extent of these needed provisions we propose next to direct our attention.

PERMANENT ESTABLISHMENT OF THE INSTITUTE.

No argument is necessary to establish the truth of what, we believe, has been generally conceded for some time past,—that the Institute needs a *change of location* and *different buildings* for the proper conduct of the work it is now doing, to say nothing of what it might be able to do with appointments in these respects better suited to its wants.* We shall therefore assume the affirmative of the foregoing proposition, and proceed at once to the statement of what we believe to be needed, in order to provide for a permanent establishment of the Institute upon a basis sufficiently extended, not only to satisfy those conditions essential to the complete development of the Institute system, but to answer the probable demands of increased capacity incident to the future growth of such an institution.

It may be proper to remark at the outset that the subject of a future establishment of the Institute on a suitable site, with buildings and collections appropriate to its educational objects, has engaged the attention of the writer for a number of years past. The leading features of the views which have been formed on this subject are, of course, all that can be given with propriety in this place,—the details would consume far too much space. In the following explanations it will conduce to convenience to consider the subject of buildings before that of site, since the number, arrangement, and uses of the former, are circumstances that would naturally enter into an intelligent judgment of the requisites that should be secured in the latter.

THE BUILDINGS.

The architectural structures necessary to the most effective carrying out of the Institute plans, resolve themselves into three classes; these are, the Institute Buildings proper, the Residences of Professors and other Officers, and the Quarters of Students.†

---

* It has in fact been understood for several years, among those acquainted with the views of the managers of the Institute, that the present location was regarded as a merely *temporary* one; otherwise, it is to be seriously doubted whether the patience of those more immediately interested, would have continued to the present time.

† Of course, such a distinction at once implies a *separation of Students' Quarters* from buildings devoted to the general purposes of instruction, the reasons for which will appear in another place.

1. Institute Buildings.—Under the title of *Institute Buildings* is included all of those structures whose uses connect them in some immediate manner with the offices of public instruction.—A variety of opinions might be entertained as to the most desirable arrangement of these buildings; and, of course, a certain deference would be had to the circumstances of location, while paying proper attention to the demands of propriety and good taste in architectural composition; but, as the result of much consideration of the peculiar wants of the Institute, at the same time having due regard to the experience of other institutions, our convictions are unhesitatingly in favor of the adoption of the following general plan.

In the first place, experience suggests the propriety of distributing the various recitation and lecture rooms, laboratories, cabinets, museums, etc., into *groups* in accordance with the distinctions incident to prominent divisions of theoretical and practical instruction; by this means bringing each group of rooms, as thus distinguished, into a distinct building, and giving to each building those peculiarities of construction which would best adapt it to the class of studies allotted to it. The following scheme exhibits the distribution which is deemed desirable,—the titles being suggestive of the uses of the building thus designated.

For the General School.

1. School of Mathematics.
2. School of Mechanics and Physics.
3. School of Chemistry.
4. School of Geology and Natural History.
5. School of Literature and Philosophy.
6. School of Geodesy.
7. School of Graphic and Plastic Arts.
8. School of Gymnastic Arts.

For the Technical Schools.

1. School of Civil Engineers.
2. School of Civil Architects.
3. School of Mining Engineers.
4. School of Mechanical Engineers.
5. School of Technologists.
6. School of Ornamental Artists.

Auxilliaries.

Library; Institute Hall; Observatory; Mechanical Laboratory; Janitor's Residence; etc.

This series of component structures, constituting what we have called "Institute Buildings," may appear somewhat formidable; but it should be kept in mind, that the plan proposed has reference to the wants of a *completely developed* Polytechnic Institution, and not alone to accommodations for a hundred, but, possibly, several hundred students. With a large part of the instruction given in the lecture form, there must be a considerable number of class lecture-rooms; and, in addition, there must be a still larger number of section-rooms for interrogations and section drills. Again, for cour-

ses having so large an amount of practical discipline, there must be a number of laboratories or working-rooms, for chemical, physical, and mechanical operations. And, again, the continuous and extensive references to instruments, machines, models, preparations, specimens, etc., suggest the importance, nay necessity, of making the most ample provisions for scientific and technical collections, cabinets, and museums, as regards the safe keeping and convenient daily use of these indispensable auxiliaries to the proper carrying out of the educational system of such an institution. Details would be unsuited to our present purpose; but with an opportunity for an intelligent examination of these details, no one, we venture to say, would suggest that the scheme here indicated proposes more extended provisions than are barely sufficient for legitimate wants.

The foregoing remarks are, we believe, sufficient to suggest the necessity of providing a considerable *number* of rooms in order to carry out the educational objects of the institution. The feature of distributing these rooms into groups in separate buildings, is not only of obvious expediency in point of general convenience, but it is consistent with a proper adaptation of the rooms to *the use of those means of culture, more or less peculiar to those great departments of education*, indicated in the comprehensive titles of the buildings in question. Moreover, while securing the conveniences and advantages primarily sought for in such an arrangement, it will be practicable, as it would be desirable to realize a certain measure of deference to those canons of architectural propriety, as respects interior proportions and details, evidently not too much thought of in the construction of educational establishments.*

With the preceding observations on the distribution of rooms, it will be proper, in the next place, to indicate the principles which should apply to the *disposition of the several buildings on the ground*. Manifestly, this should be such as to obtain for each building a proper command of light and independency of approaches, and at the same time secure a degree of compactness of arrangement alike favorable to effective warming and ventilation, and to ready intercommunication throughout the entire system. Wherever practicable,—and it could scarcely be otherwise with a proper adaptation of ground,—a disposition of the buildings in a manner to inclose one or more quadrangular courts, is clearly that which would best comport with the conditions here sought to be obtained. The quadrangular disposition of the various buildings included in the foregoing

* For example,—to say nothing more,—where lecture rooms, laboratories, recitation rooms, cabinets, etc., with extreme variations in plan are brought to the same inexorable level in elevation.

list could readily be made entirely consistent with the idea of *individualizing* these structures; since, besides the effect of giving to each those proportions which would best adapt it to its future uses, there are various architectural expedients for aiding these distinctions, even while the structures as a whole might constitute a *completely connected system.**

The advantages arising from such a disposition of the Institute Buildings, in addition to those primarily sought, some of which are very essential, are, first, the facilities afforded for a mode of construction—more or less necessary in all institutions—by *successive additions* to the buildings first erected, in accordance with a general design for the construction of the entire system; secondly, the many conveniences incident to the command of closed courts; thirdly, the architectural resources thus secured, by the variety in ground and sky outline from differences in size and proportions of the individual buildings.

2. Professors' Residences.—Every educational institution which aspires to the condition of a stable and permanent establishment should, as a matter alike of wise expediency and true economy, make ample provisions towards securing fixed and eligible quarters for the different members of its Academic Staff. Those who are devoted to the business of public instruction in our higher institutions, and whose services are worth having, are, from necessity not less than inclination, students. To such, the offer of a residence, which, besides possessing characteristics essential to the idea of a pleasant home, may be deemed not less truly a *fixed* one, is, of itself, a positive inducement to acceptance of office of no inconsiderable value; while the absence of provisions for an appropriate and permanent home, necessitating a subjection to the continually recurring annoyances incident to the position of a "tenant at will,"—apart from the general *unadaptedness* of the residences usually thus available,—becomes, not unfrequently, a positive objection to an official association with an institution thus conditioned. The "*emoluments*," at least in a pecuniary sense, of the professorial office in one of our public institutions, are too little tempting in themselves to induce a disposition favorable to much sacrifice of those facilities, which are deemed more or less essential to the realization of the principal returns looked for in the life of a student and public teacher. Fortunately —for the cause of learning—the men who are qualified and willing to enter upon such a life have a sufficiently indifferent regard for the "making of money" to be content with moderate salaries, so long as they can be assured of quiet, undisturbed homes, and can make "both ends

* The Observatory, wherever constructed, would probably require a position on the outside of such a quadrangle.

meet" at each recurring reminder of change of seasons and roll of years.

There is no practical difficulty in meeting these requirements as they might arise in the progressive development of the Institute, if care be had at the outset to secure sufficient ground in the plot designed for an Institute site. The portions of the plot destined to be used as building lots, having been once set apart for such a purpose, would need to be improved no faster than necessary to supply demands for additional residences. Under such circumstances, with but a nominal expense for ground rent, a class of houses, with rural surroundings and in architectural harmony with the Institute Buildings, might be erected at comparatively moderate cost. Such an investment would be a productive one to the Institute; since, in addition to the possession of the means of presenting a more tempting inducement to those whom it might wish to enlist in its service, every residence made over to the use of one of its officers would save the payment of an equivalent in salary quite equal to a good dividend on the amount thus invested.

In addition to provisions for family residences, a Hall for the use of unmarried and junior officers, suitably provided with lodging and study rooms, parlor, dining hall, etc., and accommodations for a family to keep it, would, for reasons similar to those mentioned in the other case, be a desideratum, in harmony alike with sound policy and true economy.

3. Students' Quarters.—It is well known that students of the Institute have always had their quarters, comprising both board and furnished lodgings, in private families variously located in town, — the students being distributed in numbers from one or two to six or eight in each house, and their lodgings being adapted to serve the common purpose of sleeping and study rooms. This mode of quartering students, which is quite as much a matter of choice as of present necessity, is far from being a peculiar one, inasmuch as a similar practice not only prevails at the principal medical and other special schools of this country, but also obtains, with occasional exceptions, at the Universities and Polytechnic Institutions over most of the continent of Europe.

A different mode of living, as every body is aware, prevails at our American Colleges, where students are provided with rooms in the college buildings, not only for lodgings and study, but also in some instances, for commons,* a practice undoubtedly derived from the system of Halls and Inns—"*Aulæ* and *Hospititia*"—so characteristic of Oxford and Cam-

* This feature is, we believe, disappearing from our American Colleges. To one at all aware of the *scenes* which have been occasionally exhibited in College "refectories," there is, to say the least, little that is suggestive of the growth of courtesy and refinement of manners.

bridge. That there are certain advantages in favor of such a system is not to be denied; but that there are many serious objections to it is most unquestionable. The advantages are essentially those of *convenience*, in certain points of view, to the student; the disadvantages are those which affect the *morale* of a student's life, during his residence at a public institution. Without attempting to illustrate the evils which naturally result from the quartering of large numbers of young men in college lodgings, far removed from all practicable restraint, we will merely remark, that there can be little chance, under such circumstances, of the cultivation of those amenities of life which originate in, and are essentially sustained by, the influence of *woman*,—without which, man, especially at such an age, displays a remarkable proclivity to relapse into a species of native barbarism.*

On the other hand, we have as little faith in the expedient of converting our higher institutions into *Boarding Schools*, as manifested in certain recent establishments. In attempting to remove the evils of the college system, the managers of these institutions seem to have thought that the only safe procedure is to be found in treating young men as *boys*, not yet quite fit to leave the nursery; in making them study in a common hall, under the eye of a teacher; in compelling them to sleep in a common dormitory under the watchful care, also, of a teacher; in allowing them to play, walk, or otherwise exercise, under the superintendence, of a teacher;—in short, whatever the pupil be permitted or required to do, always placing him under the *surveillance* of some officer of the institution. While we have the fullest appreciation for the motive, we confess to but little for the practical wisdom, which prompts and carries out such measures. It needs but little knowledge of human nature, and of the world as it is, to be able to see that such a system, however efficient it may be in preventing a boy from evil practices during his days of pupilage, is well adapted to emasculate his developing manhood, while it furnishes small security and poorer preparation, for a successful *subsequent* contact with the world—with, indeed, the practical teachings of a very different school.†

* We are glad to find the Rev. Prof. Barnard, of the University of Mississippi, in a paper lately read before the American Association for the Advancement of Education, "*On Improvements practicable in American Colleges*," taking decided ground, in clear and vigorous language, in favor of abolishing the whole system of college lodgings, and resorting to the mode of distributing students among private families, as being more favorable to morals and manners.

† We do not refer to the system of boarding schools for *younger* boys, which although falling short of what might be desired in certain respects, is on the whole, perhaps, as good as can practicably be expected. But we have reference to *collegiate* establishments, having university powers and privileges, professedly designed for the education of young men in the higher branches of learning. We beg, also, to be understoood as claiming to have the highest appreciation of the importance of carefully training the young in the principles and practice of a Christian life. The question of a possible difference of judgment is, at most, but a practical one as respects time, place, and mode of developing this species of education.

We have made more particular mention of these two different kinds of student-life, because we have heard it occasionally objected to the Institute, on a first view of its features in this respect, that it provides insufficient safeguards for the conduct of its students outside of the hours appropriated to its daily class exercises; such objection being generally accompanied by the suggested query, whether one or the other of the modes just mentioned would not prove a safer arrangement. Such a question manifestly deserves attention, in connection with the consideration of a proposed permanent establishment of the Institute, since its decision would materially affect the details of designs for architectural constructions. As already seen, in what has been said on the subject of Institute Buildings, we have suggested no provisions for the quarters, either of officers or students in these structures, with the exception of the janitor, or porter of the establishment. For this virtual rendering of judgment in favor of the existing system, we can only urge, in addition to what has been said already, our profound conviction of its practical soundness, abundantly justified by the long experience of the Institute itself, and fortified by the almost universal practice of continental Europe. We believe that such a system promises vastly more for the development of the characteristics of a manly culture and self-reliance than either of the other systems; while it may preserve — perhaps add to — those externals of manly character, which are not unworthy of some portion of every man's regard,—a degree of that gracious abnegation of *self*, so easily overlooked at such an age.*

But while we entertain no doubt of the soundness in principle of this mode of quartering students, we have long thought that its details were susceptible of considerable improvement, — affecting the interests alike of the Institute, its students, and the families that furnish the latter with temporary homes. Students are now necessarily too much scattered over the town; their rooms, from the absence of all original adaptation, are quite too often deficient in light, in ventilation, and in those provisions more or less essential for their comfort and general well-being; they are occasionally

* We cannot but regard the whole system of sumptuary laws and petty *espionnage* deemed essential to it, which enters so largely into the internal administration of most of our classical colleges, to be as unsound in morals as it is impracticable of execution. Such a system may present a favorable field for the cultivation of *finesse* in circumventing laws or evading the consequences of their infraction; it may teach the student bravery in expressing his enmity to, or contempt of, college officers; but we are utterly unable to see what other good it can possibly accomplish to college or students. We are aware, however, that the system of the Institute is not perfect,—that there are, occasionally, those of its students who fail to realize all that is here predicated of its system of student-life; but this, of itself, proves little against it. A true *experimentum crucis* would be had in an actual *comparison of relative general results of the* morale *of the College and Institute systems.* To such a test we should be willing to leave the decision of the question.

subjected to capricious and unwarrantable exactions, making the cost of living not only uncertain, but too high for the accommodations afforded; and finally, on account of the limited capacities of the houses in which quarters for students are found, the number of families furnishing these quarters has become so considerable, — a difficulty which is, moreover, continually increasing, — as to make it not always practicable to select with the requisite discrimination the places which are offered for this purpose. These difficulties and inconveniences are inevitable with existing arrangements; and yet, we believe they might be nearly or altogether removed by the adoption of a well-conditioned *system* of Students' Quarters, in connection with a permanent establishment of the Institute, under the requisite favoring circumstances.

In accordance with the teachings of experience, we believe, that in order to secure the desideratum of appropriate quarters for students, the requisite ground-plots should be set apart, — either in, or adjacent to, any proposed purchase of Institute Grounds, — on which should be erected as needed, a class of establishments alike suitable for quarters of students and residences of the families destined to occupy them. Each of these establishments should be provided with suitable lodging and study-rooms, common parlor, dining hall, etc., for the complete accommodation of ten or twelve students, in addition to the rooms and other offices set apart for private family use. The aim should be to provide suitable and eligible quarters for students, in connection with arrangements and appointments compatible with the greatest comfort and convenience to the families that might be induced to conduct these establishments.

We believe that a class of establishments thus built up, with due regard to architectural and gardening externals, would become attractive homes for families and students, enabling the Institute to command a superior class of families as tenants and keepers of these houses; and while affording the means for perfecting its system of student-life in all its various details, we believe that the whole could be made eminently productive to the Institute as a mere pecuniary investment.

THE SITE.

The preceding remarks on the various architectural constructions needed for the most effective carrying out of the educational plans of the Institute, would naturally be suggestive of some of the conditions which ought to be fulfilled in the plot of ground intended for an Institute Site. There would be little wisdom, however, in proposing any details in connection with the disposition of buildings and general improvement of a site in ad-

vance of its actual and definite location; since, any judicious improvements of this kind, would have to be considered in direct reference not only to the characteristics of the site itself, but to those of its surroundings. The most that can be properly done in this connection is to perceive the wisdom of making the most ample provisions in respect to *extent of area* selected for a site The mistake of purchasing too much ground is easily remedied; but the error of securing too little, is, as all experience has shown, most difficult, if not altogether impossible, of satisfactory future adjustment. It would be impracticable,—perhaps, unadvisable,—to fix with precision the minimum quantity of land that would be sufficient, in advance of any knowledge of its characteristics of surface, form, and surronndings. It should, however, be kept in mind that, in addition to land enough for mere *ground-plots* of the various structures to be erected, originally or at any subsequent period, there should be sufficient breadth in all directions, not only to secure the requisite areas immediately adjacent to these structures for purposes incident to their proper use, but also to admit of the production of those æsthetic effects from judicious architectural and gardening treatment, which should by no means be overlooked in the permanent establishment of such an institution.

SCIENTIFIC AND TECHNICAL COLLECTIONS.

We come, in the next place, to speak of those important auxiliaries to the educational purposes of the Institute, previously referred to under the name of *Collections*. The Institute already possesses Collections of Physical and Chemical Apparatus, Geodetical Instruments, Drawing Models, etc., and Cabinets of Minerals in Systematic Mineralogy and Geology, which, although, less complete than would be desirable, have, nevertheless, been made to answer in the absence of collections better suited to its wants. The following schedule will present, in a suggestive way, an idea of the nature and extent of the collections which should be possessed by the Institute, in connection with the full development of its educational plans.

I.—General Scientific School.

1. Collection of Physical Apparatus.
2. Collection of Chemical Apparatus.
3. Cabinet of Natural History.
4. Cabinet of Systematic Mineralogy.
5. Cabinet of Systematic Geology.
6. Collection of Geodetic Instruments.
7. Cabinet of Geometrical Graphics.
8. Cabinet of Antique, Mediæval, and Modern Art.
9. Collection of Gymnastic Apparatus.

II.—General School of Technical Studies.

10. Collection in Practical Mechanics.
11. Collection in Analytical Chemistry.
12. Cabinet of Materials used in Construction.

13. Collection in Industrial Physics.
14. Cabinet of Practical Geology.
15. Cabinet of General Constructions.
16. Cabinet of Machines.

III.—Special Technical Schools.

School of Civil Architects.

17. Cabinet of Architectural Constructions.

School of Civil Engineers.

18. Cabinet of Engineering Constructions.

School of Mining Engineers.

19. Museum of Mines.
20. Collection of Metallurgic Apparatus.
21. Cabinet of Metallurgic Works.

School of Mechanical Engineers.

22. Cabinet of Machine Constructions.

School of Technologists.

23. Cabinet of Raw Materials.
24. Cabinet of Technological Works.
25. Museum of Commercial Products.

School of Ornamental Artists.

26. Cabinet of Models of Ornamental Art.
27. Museum of Products of Ornamental Art.

The collections already possessed in connection with the courses of the General School, are fairly developed, with the exception of (8) and (9) which have not been commenced. The Physical Collection is deficient in certain respects. The Chemical Collection,—both for General and Analytical Chemistry,—is measurably sufficient. The Cabinets of Minerals are not what they should be, although a lack of room has prevented the putting up of all the minerals actually possessed by the Institute. The Geodetical Collection includes instruments both for Field Geodesy and Practical Astronomy,—the latter portable instruments adapted to temporary stations,—and is in a state to be used with tolerable satisfaction; it is, however, much in need of certain additions. The Cabinet of Geometrical Models is small but improving. With respect to Cabinet (8) we may remark, that a collection of Casts is in the highest degree essential to appropriate and satisfactory studies in Free Drawing and Modelling. Such Casts are now obtainable abroad, of a high degree of excellence, at moderate cost, and to a sufficient extent to present a satisfactory exhibition of Antique, Mediæval, and Modern Art. A Gymnastic Collection, (9), it need only be said, would be useless until a suitable building were erected.

The collections of the General Technical School are, as yet, scarcely commenced. Such collections could be rapidly formed; but in the utter absence of rooms for their safe keeping and convenient use, there would be no propriety in attempting their formation, however desirable. Similar remarks are applicable to the collections of the Special Schools. In both cases, in the absence of these much needed means, resort has been had to drawings as far as practicable, aided by direct reference to certain structures near the city, usually visited, measured, sketched, and drawn out in full, by the Institute Classes, in connection with the courses in Geometrical Drawing.

Much might be said in elucidation alike of the nature and importance of each of these collections, (10) to the (27) inclusive; but these details, how-

ever interesting to one who has thought much of these things, would scarcely be appropriately introduced in the present connection. We only hope that their titles, merely, may be in some small degree suggestive of the importance which we attach to the presence and *use* of such auxiliaries in our educational system, and which, we believe, can scarcely be overrated.*

A gathering together of such collections is the work of continuous years; but, with suitable rooms and cases, the *nuclei* of all these collections, sufficiently extended in each case to answer most valuable practical ends in scientific, technical, and artistic instruction, could be very promptly made, with the experience which could be rendered available to such a purpose. The cost of the collections, for such a series of *beginnings*, would not be a very serious matter. Many of the models of structures, machines, works, etc., executed in plaster and wood, might be obtained abroad more economically than they could be produced at home.† Large accessions could be had by donations from various sources. The essential preliminary, however, to the building up of these collections, is the possession of the requisite buildings.

In addition to the collections noticed in the foregoing list, an *Arboretum* and *Botanic Garden*, would be highly useful in many respects to the interests of instruction. An Arboretum could be gradually developed in the

---

* We have long believed that the Institute should possess some facilities for, and devote a certain degree of attention to, researches for the *advancement* of Practical Science. Many subjects of importance come up among the teachings of such an institution, calling for special experimental inquiry, in order to make our knowledge on the matters thus involved, more accurate—sometimes more practical. As an illustration of such deficiencies in American Practical Science, we may allude to the condition of our knowledge of *materials* used in architectural and engineering constructions in this country. With the exception of a very few experiments here and there made on our own materials, the few professional men in this country, who ever trouble themselves to calculate the proportions of a structure, are obliged,—with the aid of a somewhat questionable induction,—to depend on the results, mainly, of European observations made on *European materials!* The conduct of such researches, otherwise necessarily expensive, would be largely aided by practical men, immediately interested in the results of such inquiries. Indeed, we have had the question more than once asked by these men, whether such researches could not be practically undertaken by the Institute.—We make the remarks contained in this note in reference to collections (10) and (11) among others of the foregoing series, in which the possession of facilities for the conduct of these and similar researches in Practical Mechanics is thus contemplated.

† A practical, and at the same time economical, way of building up the various collections of models, in plaster, wood, and the metals, and in fitting up apparatus of various kinds, would be found in the continuous employment of a skillful artisan. To this end, among the arrangements of a permanent establishment, there should be rooms suitably furnished for the employment of one or more workmen, for these and similar purposes, under the direction of the Institute. The *instruction in modelling* would be given in this connection. With the use of steam as a means of warming and ventilation, the requisite facilities would be had for the use of motive power.

gardening treatment of the Institute Grounds, if, instead of making plantations of trees and shrubberies of a few of the more common species, care were taken to collect an extensive representation of *different* species, indigenous and exotic, so far as means might be available to such an end. The Botanic Garden could have its assigned place on these Grounds.

Among the permanent collections of the Institute, the building up of a *Library* should, by no means, be overlooked. A Polytechnic Institution in addition to other resources needs all that can be obtained from the command of books. Besides General Literature, and General Treatises and Monographs on Theoretical and Practical Science, its Library ought to be completely supplied with the different Scientific, Technical and Artistic Journals, and the Transactions of Learned and Professional Societies, Foreign and American.

CORPS OF INSTRUCTORS.

We come in the last place to make a few remarks concerning the Professorial Corps of the Institute. The idea of the Institute, in this particular, comprehends two classes of instructors in its work,—Resident and Non-resident Professors, the former being supposed to have their services exclusively engaged by the Institute, and the latter, whether actually resident in town or elsewhere, being employed to give instruction in certain limited specialties, and of course not fully occupied in Institute service. By this means, the feature of dividing the labors of instruction in accordance with those peculiarities of individual fitness for, and cultivation of, certain specialties of knowledge, is intended to be made practically available;—without which, the work, not less than the results of instruction, becomes a sorry business to all concerned.

The following schedule gives a statement of the Chairs of Instruction proposed for the Institute, many of them, of course, having never been filled.

Chairs of Instruction.*

Mathematics and Astronomy.
Mechanics, Machines, and Constructions.
General Chemistry and Physics.
Theoretical, Practical and Mining Geology.
Descriptive Geometry and Geometrical Graphics.
Mining and Metallurgy.
Architectural Design.
Construction of Machines.
Physical Geography.
Political Economy and Jurisprudence.
Physiology and Hygiene.
Gymnastics.

* No reference is made to *assistants* of any kind,—the titles here given having respect solely to those who are supposed to constitute members of the Institute Faculty,—that is *Professors* in their respective departments, in the sense in which the word is legitimately used.

Geodesy and Topography.	Æsthetics.
English Composition and Criticism.	Landscape Gardening.
Natural History.	Ornamental Art.
French and German Languages.	Modelling.
Intellectual and Ethical Philosophy.	Inductive Philosophy.
Railway Economy.	Technical Chemistry,
Free Drawing.	Social Arithmetic and Statistics.

In respect to the list of Chairs here given, it may be remarked that the *first ten* only have actual incumbents. The titles of those not yet filled are, of course, provisional, subject to such modifications as would be suggested in fixing the limits and details of the departments of instruction to be hereafter associated with these Chairs; in certain cases, a title is more comprehensive than would distinctly appear from its face; and, in the progress of Institute development, with any considerable increase of students, there might and naturally would be subdivisions of these departments consistent with the greatest efficiency in their practical administration.

It will be noticed that "Civil Engineering," "Mining Engineering," etc., do not appear in the list of professorial titles. In our own view of this matter, we can scarcely avoid thinking that there would be equal propriety in uniting, in one person, as a *Professor of Medicine*, an entire faculty of teachers of its various component parts,—Anatomy and Physiology, Pathology, Therapeutics, Materia Medica, etc.,—as in investing any single person with the functions of instruction in the extensive and very different branches of knowledge which properly make up the professional education of the Engineer, and styling such an one a *Professor of Civil Engineering*. Such a practice,—unknown so far as we are aware among the Polytechnic Institutions of Europe,*—does not seem to us entirely compatible with the realization of that degree of extended, exact, and practical instruction which the present state of engineering knowledge would appear to demand at the hands of its professional teachers.†

---

* The titles of the subjects of study in the various programmes of the courses given in connection with the notices of these institutions,—pages 9 to 30,—are, in general, coincident with those of the professorships in the same institutions.

† We cannot speak from much actual knowledge of the interpretation *practically held* by "Professors of Civil Engineering," in respect to what constitutes professional learning, and we should exceedingly regret to make a single assumption inconsistent with the strictest justice to all concerned; we beg, therefore, that the above remark be understood as an expression of a simple *query*, although suggested to the mind of the writer by considerations, the force of which he cannot well resist.

It not unfrequently happens that students come to the Institute with the idea that "Civil Engineering" consists essentially in a knowledge of *Instrumental Field Operations*—that is, of mere surveying, staking out, measuring, etc.,—apparently entirely ignorant that the objects to be secured by these very necessary *auxiliary* operations are the *Construction of Works*, which must or *should be duly designed by the Engineer*. Alas! we fear that many more Missouri accidents,—to say nothing of hundreds of similar ones which destroy property, not life,—will be required to

In connection with this subject, we will add a further remark. In the administrative economy of the Institute, a department of *conduct* is associated with the various departments of Instruction, in respect to all of which records are made and class standings obtained.* We have for some time thought that, with the increasing number of students at the Institute, a necessity would soon arise for the creation of an office whose duties should have reference solely to the conduct of students,—the incumbent of which to be a chief in the department of conduct, as a Professor of Mathematics is, in the department of mathematics. The title of the officer is not very material; he might be called a *Proctor*, as in the English Universities, though better, we think, a *Commandant*, as in certain other institutions.† The *Professorship of Gymnastics* might very appropriately be joined, at least for a time, to such an office,—uniting the functions of both in the same properly qualified person. Of course, all this need not entail the necessity of making the Institute a *Military Institution*,—not even of putting its students under a military government, as at the École Polytechnique; although in connection with the daily drills in practical Gymnastics and in all others of a physical kind, the introduction of the precision of movement characteristic of military training, would, we believe, be of no inconsiderable advantage to the students, as well as to the general interests of the Institution.

---

teach our people that an Engineer's education should be something different from that too generally received in this country;—his matriculation in the field with knowledge enough to drive a stake or hold a rod, and his virtual graduation in the same theatre when he has become sufficiently learned to run a line or determine a level;—and, indeed, to correct the very prevalent disposition with the popular mind to be satisfied with superficiality and empiricism under the much abused name and much more specious form of "practical" (?) knowledge.—As if there could be any really *practical* knowledge, in conflict with the immutable laws of nature!—As if one must be disqualified to become a "practical man," after having acquired even a *little* accurate knowledge of these laws!

* See "*Institute Statutes*,"—Annual Register for 1856. This department takes cognizance of the characteristics of each student's general conduct,—his attendance at all class or section exercises,—his deportment when present, etc.,—of all which a record is made, and *an order in class standing* obtained by an induction founded on these data. This, with a series of similar class standings in each of the departments of instruction, gives a basis for the determination of a *General Order of Class Standing*, in which the relative *weight* of the different departments is included, as well as the relative order of standing of the student in each of those departments.

† The associations connected with the office of a Proctor would make this somewhat undesirable, apart from the fact that the principles of government of the Institute are, as we hope they may ever be, very different from those which obtain at the English Universities.

In respect to the practical realization of the views which have been presented on the preceding pages, we submit the following remarks:

Whatever else may be deemed desirable towards the improvement of the Institute, the first step taken should, undoubtedly, in the order of relative importance, look to the immediate consideration of a suitable site and the requisite structures for an appropriate and permanent establishment. With the experience now possessed by the Institute it will be practicable to take full cognizance not only of its immediate but prospective wants; and, accordingly, in the projection of a design for architectural and gardening improvements, its study should be *complete* for all that may be proposed in connection with such a site; or if there should be any doubtful points, disposing of them in a manner to bring them within the control of future contingencies.

But it is scarcely to be expected that a design regulated by such principles could be wholly executed immediately; neither would it be necessary, for parts of it must have reference to future rather than present wants; and besides, the *means* for carrying out so extended a system of improvements, it is hardly to be presumed, would be at once available. Hence would arise the necessity, not less than propriety, of determining, in advance, how much of the general design should admit of immediate execution. In the absence of anything but conjecture as to the amount of means which may be found available for carrying forward these improvements, it would be utterly futile to make such an inquiry, at this time, even if a design were fully matured; with, however, the necessary preliminaries settled, the question, *what and how much* should be first done, may be easily answered before striking a blow towards the actual execution of any part of it. Whatever be done, now or hereafter, in the execution of any portion of a scheme of improvements thus projected, should be in strict conformity, both in style and treatment, to the design which may finally be adopted, at least so far as shall be practicable,—a mode of procedure essential to the due preservation of that measure of unity and harmony, which *ought* to be a desideratum, both in the design and execution of these and similar works.

Simultaneously, with the building up of structures and improvement of grounds, could steps be taken for establishing the foundations of many of those much needed auxiliaries to instruction,—the scientific, technical, and artistic collections,—which would then become so far advanced towards practical attainment, that there would at least be rooms for their due preservation and use.

In respect to additional officers of instruction, it should be remarked, that the want of the requisite rooms and collections would be an obstacle, even if there were no other, in the way of much progress in this direction. Such additions, how important soever to the full realization of the Institute plans, must, for the most part, remain in abeyance until permanent and suitable building improvements shall have made a degree of actual progress, sufficient to justify the expediency not less than the practicability of effecting the necessary arrangements for the realization of results so desirable.

CONCLUSION.

We have seen that, in those States of Continental Europe where we have long been accustomed to look for the best systems of general education, there are indications, as suggestive as they are numerous and striking, of a new phase of educational progress, the complete history of which scarcely extends farther back than the beginning of the present century, a large part, indeed, not beyond the limits of the past thirty years. Institutions have sprung up at numerous points, with establishments, in some cases, of palatial magnificence,—with extended and costly collections,—with well-organized faculties of accomplished instructors,—with large and increasing numbers of students in attendance,—with, in short, all of those indications of intelligent appreciation, by government and people, which, in the history of these institutions, are among their most remarkable and noteworthy features.* We have already indicated the leading features of this great educational movement, in the sketches which were given of the principal Technical Institutions of France and Germany, in a former part of this paper; and, in a subsequent review of these institutions, we attempted to illustrate the *idea* of the Polytechnic Institution, by a description of its leading characteristics as they would be found displayed in the objects, curriculum, and methods, of a typical or generalized representative. Our main object in all this, as had been previously stated, was to prepare the way for a more intelligent and complete understanding of our own Institution. We have at no time intended to present a formal argument for Polytechnic Institutions as a class, nor in any special sense for the Institute

* It has been seen that, at the Polytechnic Institute of Vienna alone, there was, in 1852, an attendance of 3400 students, of whom about 1700 were in *regular classes.* And according to Prof. Playfair's estimate, made during the same year, "at least 13,000 well-qualified students are being every year systematically instructed in the industrial institutions of Germany," in addition to 30,000 to 40,000 students who attend partial courses.—"*Industrial Instruction on the Continent.—London,* 1852.

itself. We have not deemed this necessary, or even expedient. So far as the Polytechnic Institution of the Continent of Europe is concerned, it may very properly be said that it has already had too long a period in which to *try its usefulness*, to be considered at this day in any respect an experiment. Its necessity to the State, its manifold usefulness to the people, and its spirit not less than its capacity of adaptation to the great and pressing wants of the present era in man's progress, have been too well and too long understood, to leave occasion for wasting words, in mere discussion of these points. We have therefore preferred to be suggestive rather than argumentative, feeling confident that the *facts* which have been presented in connection with the objects, characteristics, and results of this class of educational institutions, would appeal most forcibly to the common-sense appreciation of every intelligent and thoughtful man.

But while indications such as these exist on the Continent of Europe, it is far otherwise in this country. We have, it is true, a number of "Scientific Schools" in connection with as many different Classical Colleges; we have four or five institutions, recently established, which at least use the word "Polytechnic" as a part of their respective titles; and we have finally the institution located in our midst; but we have little which, in any proper sense, can represent to us the idea of a completely appointed Polytechnic Institution.* It might well be a matter of marvel that, with a country possessing natural resources so extraordinary, and permitting every reasonable freedom of action in schemes of private enterprise, we should still be, in our educational resources for the advancement of industrial instruction, a full quarter of a century behind some of the more or less *despotic* States of Continental Europe. But it should not be supposed, because there is at the present time so little opportunity for this kind of educational culture in the United States, that a corresponding indifference and inappreciation prevail in regard to it. Evidences of a desire for something better are by no means wanting. Of these, to mention no other, the Schools of Science already alluded to—the establishing of which has become quite a fashion of late—afford illustrations directly in point; since there can be little question that these institutions owe their existence to indications of a popular sentiment which could not be misunderstood.

Much has been said, within a few years past, on the subject of a National University, to be located somewhere in the United States; the history

* We have not mentioned in the foregoing enumeration the two Government Institutions,—the Military and Naval Academies. These two institutions,—the former of which has long been doing equal honor and service to the country,—although belonging to the class of Polytechnic Institutions, are restricted to certain branches of Government Service.

of which, besides being eminently suggestive in its various bearings, is in point as furnishing evidence of a similar public sentiment in favor of scientific and industrial instruction. We are aware of the attention which was attracted to the numerous meetings and discussions, held in a neighboring city, four or five years ago, and of the interest which was created in behalf of the proposition to establish such an institution in that city. Men prominent in letters and science were invited to attend these meetings; they were also attended by many of the leading citizens who participated or were interested in the discussions which took place. A Legislative charter was obtained; and, in the fall of 1850, the following announcements were made of the opening of the scientific and industrial department of the proposed University.

"School of Natural and Applied Science."

"*Principles and Practice of Agriculture.*
Chemistry applied to Agriculture and the Arts.
Zoölogy and Comparative Anatomy.
Civil and Mechanical Engineering.
Mineralogy, Metallurgy, and Mining.
Meteorology and Physical Geography.
Geology and Palæontology.
Astronomy."

"It is designed to have these branches taught with special reference to their *practical* application in the various pursuits of life.

"The importance of presenting the means and facilities for acquiring a knowledge of *Scientific Agriculture and of Engineering,* is daily increasing in proportion as the rapid development of the physical resources of the country is progressing.

"Under the former will be included *Principles and Practice of Scientific Agriculture; Chemistry, Geology, Botany and Vegetable Physiology, Zoölogy and Animal Physiology; Meteorology and Physical Geography* in their various applications to agriculture. Under *Engineering* will be included *Mathematics* as applied to engineering and mining, *Natural Philosophy* as applied to the mechanic arts and machinery, *Metallurgy, Geology, and Mineralogy* in their applications to engineering."*

In accordance with these announcements, several courses of lectures were given during the subsequent year; and yet, although started under auspices apparently so favorable to complete success, we believe that the results were not very satisfactory, either to the accomplished men of science who assisted to inaugurate the undertaking, or to the public-spirited citizens who prompted and sustained it.

* *Circular of the University of Albany,—Albany,* 1851.

An interesting question might naturally arise as to the causes of a failure apparently so decided. This we do not intend to discuss; although in passing we venture to remark that we cannot attribute this result solely to the effect of circumstances incident to immature and undeveloped arrangements at the opening of this enterprise; nor do we believe it would be difficult to show that there are obstacles to be encountered *at the very threshold* of such an undertaking, which would forbid the expectation of materially better results in a second essay of the same kind, even with more complete initial arrangements.*

Our motive, however, in alluding to the University movement was not to criticise it, but to call attention to certain significant characteristics of its more immediate results, those, especially, which were prefigured in the announcements of 1851. So far as the mere titles of certain proposed courses of lectures and the brief explanations which accompany them, can be made the basis of a definite judgment as to the objects and plans of an educational institution, it would seem to be reasonably certain, that

* It may be deemed by those who have thought little on this subject—perhaps by others who have thought much—somewhat presumptuous to offer a judgment different from that impliedly rendered by the many eminent scientific and literary men who were most conspicuous in the movement for such an educational institution. Our convictions are, nevertheless, that one of the most serious obstacles to the legitimate success of the kind of institution proposed, would be found in the difficulty of commanding a sufficient number of students, to constitute a permanent and paying nucleus of an auditorium, disposed to avail themselves of the teachings of "Higher Science," *who would be found qualified with the requisite educational preparation to make such teachings practically available.* Of course, we do do not suppose that there would be any difficulty in erecting buildings, furnishing collections, and even *endowing* professorships for such an institution. *Money* will do all this; and under certain circumstances there is little difficulty, in obtaining it; but while the Professor's safety would in this manner be provided for, he might still be compelled to lecture to empty benches. This may be saying a good deal; but we commend it to the attention of those who suppose that any considerable audience of students, prepared to listen to expositions of subjects of theoretical or practical science, requiring, for example, the use of the higher mathemetics, is reasonably to be expected, when the oldest and most prominent of our classical institutions require but the mere elements of algebra and geometry in their educational courses. And what is now predicated of the higher departments of mathematics, mechanics, astronomy, and physics, is scarcely less true of the higher inquiries connected with chemistry, mineralogy, natural history, geology, and geography.

We yield to none in the earnestness of our convictions of the *need* of opportunities in this country for the study of the higher inquiries in science,—of our need, if it shall be so-called, of a "University" for the accomplishment of such an end; but we first need—what Germany has and we have not—a system of secondary instruction which shall be capable of furnishing the requisite disciplinary preparation to students disposed to enter upon such higher instruction.

† There is no intimation in these announcements that a general curriculum was to be adopted; indeed, the presumption would be against such a supposition, since the idea seems to have prevailed that the University, like its German prototypes, should allow each student to pursue *any one or more* of the several courses,—leaving him free to make out his own course of study.

the *aims* of those concerned in the arrangement of these preliminary details, were little different from those which in other places have originated Polytechnic Institutions.† It seems, indeed, sufficiently evident that this movement, in respect to which there was so much discussion elicited and interest excited, when it came to involve the consideration of the details of a practical organization, conducted at once to the adoption of measures for scientific and industrial instruction. Of course, it is not here assumed that, in the mode of carrying out its various measures, the University establishment would have borne much resemblance to a Polytechnic Institution; but it is enough for our present purpose to have been able to show, with sufficient distinctness, that, in the *general objects* of the proposed institution, the desire of its managers was to provide certain facilities for the instruction of that class of students, for whose complete educational training Polytechnic Institutions are more or less especially designed.

With these evidences—and they might be multiplied by a consideration of the subject from other points of view—it would be unreasonable to conclude that there is any real lack of interest among the American people in respect to scientific and industrial instruction. But while there can be no doubt of the existence of a pervading and growing desire among our people for such instruction, it is not to be overlooked or denied that there are obstacles to the most satisfactory educational progress in this direction. A restless spirit of activity and enterprise, partly from inheritance, though largely from favoring circumstances, has come to wear the appearance of a permanent national characteristic. With this is naturally enough associated an impatience, very frequently exhibited by our American youth, for a transition the most rapid through the "days of pupilage," the ever pressing consideration in the mind of the student looking less to the excellence of the training to be acquired, than to the shortness of the time in which it may be accomplished. "Education" under such circumstances is more likely to involve crudeness and superficiality than breadth and accuracy of knowledge, to say nothing of the practical impossibility of realizing one of the most important of the immediate results of all true education,—a well-balanced and well-regulated mental discipline.

Nor is this state of things inconsistent with the pervading appreciation of popular education which obtains in this country. There is, perhaps, no people more alive to the importance of diffusing the advantages of such an education than our own. But with facilities for primary education so generally accessible, that to be unable to "read and write" is justly considered a reproach alike to the individual so distinguished and to the community that tolerates him; with facilities for the diffusion of "popular knowledge"

by means of lectures, books, and periodicals, the most unrestricted that can well be conceived or desired; with advantages such as these, and yet, it is most undeniable that, as a people, we are not correspondingly remarkable for always avoiding the delivery of very superficial judgments on questions, which properly demand more or less of careful examination and strict scientific scrutiny. In fact, with intelligence and invention to a degree which has become proverbial, there can be little question that we manifest a propensity to adopt the views and patronize the methods of the sciolist and empiricist quite as readily, to say the least, as those of the more exacting but often less pretentious scientist.

But, in fine, whatever be the causes of such a state of things, or remedies which might be most relied on for their removal, it may be safely asserted that, if any country can be benefitted by the establishment of Polytechnic Institutions for the diffusion of the advantages of a thorough and comprehensive system of scientific, technical, and artistic education, then no other country on the globe could expect to reap so large returns, in every way, from the establishment of such institutions, as our own. But in order for institutions of this class to achieve the objects for which they are properly created, they must be permitted—we say more, they ought to be required—to set forth carefully studied *curricula*, reasonably comprehensive and judiciously proportioned, which should be *rigorously carried out in all their parts* in respect to every recipient of graduation honors. Such characteristics, stringently enforced, would be somewhat unpalatable to the taste which at present more or less generally prevails in this country, but they are such as even now find many friends among us, while they would rapidly gain in popularity among the thoughtful and discriminating on every side.*

* We are unconscious of the least proclivity towards the Procrustean idea of compelling every body to submit to the same system or even to the same quantity of educational training. While we frankly admit that our sympathies are fully enlisted in behalf of what may be called Polytechnic training, we have throughout these pages had in view the educational interests of certain classes, though large and important, in every highly civilized state. We have not dreamed of *substituting* our system as such for every other. Neither should we deem it reasonable to expect that every aspirant for the career of an Engineer or other professional Technist, would be able to comply with a prescribed formula as to the degree of educational training. But we would, nevertheless, establish definite standards of professional education; and while the educational institution should be open alike to those who were and to those who were not able to take complete courses of instruction, the distinction of *graduation*—of authorized professional preparation—should be unequivocally and substantially marked, not in the mere fact of a certain period of time having been fulfilled,—as if this could be any proof of acquired scholarship!—but in the exhibition of rigorous and systematic tests of the full and satisfactory grasp of the various parts of the courses prescribed for graduation honors.

Institutions for educational purposes, organized upon such bases and administered in accordance with such principles, are, we believe, desiderata in our rapidly growing country. They would do much unquestionably towards the training of bodies of men adapted to the carrying out of a rational and judicious professional practice in the various departments of industrial development; and, to say nothing else, they would in due time contribute not a little to the development of a sounder popular judgment, in respect to many of the most important questions which naturally interest a free, and active, and enterprising people, conscious of the possession of material resources and the various elements of a national prosperity, unparalleled in the history either of ancient or modern times.

B. FRANKLIN GREENE,
DIRECTOR OF THE INSTITUTE,
and Professor of Mechanics,
Machines, and Constructions.

POSTCRIPT.

The foregoing paper was, for the most part, written and put to press, prior to the first of January, but the pressure of professional duties of more immediate urgency has compelled a complete suspension of its concluding portions until the present time.

B. F. G.

TROY, May 10th, 1856.

STATEMENT OF THE COMMITTEE.

The undersigned, a Committee appointed by the Trustees of the Rensselaer Polytechnic Institute to the immediate charge of the general interests of this Institution, in connection with a proposed movement for its permanent establishment, submit to the citizens of Troy the following statement:

A movement is now proposed by the Trustees, which has for its object, *the appropriate and permanent establishment of the Institute, on a suitable site, within the limits of the city of Troy.*

It may be known to many of the citizens of Troy, that the Trustees of the Institute have had in contemplation, for several years past, the ultimate establishment of this institution on a permanent basis, and on a scale more worthily adapted to its educational objects. The increasing urgency of such a step became at length so apparent that, in the fall of 1853, measures were taken for a careful examination of the extended plateau east of the city, with a view to the selection of a plot of ground for an Institute site. Since the adoption of these initiatory measures, there has been considerable discussion on the subject of a site, but no definite conclusion was reached until quite recently, when a selection of ground was finally made which has been adopted by the Board of Trustees, with entire unanimity, as its choice for a permanent location of the Institute Establishment.

The plot of ground which has thus been selected, and in respect of which terms of sale and right of refusal have already been obtained from its present owners, is very eligibly situated at a distance of about three-fourths of a mile in a north-westerly direction from the City Hall. The tract is rectangular in form, and comprises rather more than thirty acres in extent, with a surface which, while for the most part nearly level or slightly undulating, rises gradually from all sides towards its centre. The culminating or central portions of the ground command extensive views in all directions.—Such are the general characteristics of the plot of ground selected for the site of a proposed permanent establishment of the Institute; it is believed

that they are such as to adapt it in an eminent degree to the wants of the institution, in the general carrying out of its plans of future development.*

The necessary steps are now being taken towards the elaboration of complete architectural and gardening designs, which will provide for the distribution, proportions, and construction of the various buildings, and for the treatment in detail of the grounds to be embraced in the Institute purchase. It is intended that the designs for the architectural constructions and gardening of grounds, shall be studied with reference to the probable future as well as the present wants of a completely developed Polytechnic Institute, and that these designs shall provide for a unity of purpose, a harmony of treatment, and perpetuity of results, in accordance with the dignity of the objects of such an institution. It is, however, expected that, while the designs shall be complete in themselves, so far as possible, their execution can be but partially realized at first, or at the most, only in proportion to the means obtained for this object,—in which case the first constructions will embrace those parts of the whole which shall be deemed necessary for the more immediate wants of the Institution.

The foregoing statement sufficiently indicates the present position of the Board of Trustees. The Trustees are desirous not only of effecting a permanent establishment of the Institute, but they fully concur in the views of the Director, as exhibited in the preceding paper, in respect both to the wisdom and expediency of making full provisions for the appropriate development of its educational plans.

With the ample response which has been made by the Director to the request of the Committee, there is little occasion for further explanations under this head—that is, in respect to *What the Institute would desire to do.* The business of the undersigned is evidently reduced to the consideration of the practical question, *Can the educational plans of the Institute be realized?*

But a reference to the statements of the Director, in respect to the present position of the Institute, will show, satisfactorily, it is believed, that even the last question may be reduced to a much simpler one,—*Can a sufficient amount of funds be raised to carry out these proposed improvements?* This is really the gist of the whole question, in respect to a proposed permanent establishment of the Institute in connection with a full development of its educational plans. There is no other

* The proposed site may be thought by some to include more ground than is necessary. The question "How much, as a minimum quantity, would suffice for the wants of the Institute," can only be intelligently answered, by *a due consideration of the details of the requirements which must be fulfilled* in the proper carrying out of the Institute plans. In the present case, it can be made sufficiently evident that there is no *excess of ground* embraced within the proposed purchase.

question, as such, involved in the present issue. There can be but one opinion in the minds of those intimately acquainted with the present state of things, that the Institute might pass at a single stride from the limited operations incident to the constrained circumstances which now circumscribe its action, to the full working results of a completely appointed Polytechnic Institution, if it were placed in possession of those merely material resources in respect to buildings, collections, etc., essential to the idea of such an institution. The Institute asks for nothing but *money* in order to the accomplishment of all its plans.

There is peculiar propriety in enabling the Institute to realize its hopes of becoming at least a worthy counterpart of its European contemporaries. For nearly twenty years this institution was the only School of Practical Science in the United States. The impetus which its teachings early gave to the proper study of Chemistry, Natural History, and Geology, although occasionally acknowledged,* is scarcely possible of adequate appreciation at the present time. Its graduates, whether as Chemists, Geologists, or Naturalists, were so instructed by its teachings, so disciplined by its unique system of training, that they were able to make their knowledge at once practically available, either in successful subsequent studies for the advancement of science itself, or in equally successful applications of it to the demands of active life. Nor was this all. For not only was the Institute distinguished for its teachings in the branches of science already named, but it also became known for its early introduction of a course of practical studies in connection with the "Applications of Mathematical and Physical Science to Civil Engineering," which, although lacking much of the systematic and extended treatment of later times, nevertheless, contributed available helps to the educational fitting-out of a body of men who have

* At the Albany meeting of the American Association for the Advancement of Science, in August, 1851, a session of the Association was held on the invitation of the Institute, at its Rooms in Troy. The following extract is taken from an editorial notice of this session in one of the daily papers:

"Prof. Agassiz,—the President for that year—said, 'the Association had met here, at the invitation of the Rensselaer Institute, an institution founded for the Advancement of Science; it was therefore highly proper that the Association should meet here, and he only regretted that time would not admit of their remaining longer.'

Prof. W. B. Rogers,—in an introduction to his paper on the *Passing of Anticlinal Axes into Faults*,—paid a very happy tribute to the memory of Mr. Van Rensselaer, the Founder of the Institute which bears his name. He said that, 'He had left a legacy the richest that man can transmit; the results of his liberality in establishing this institution—a more meritorious than which the country could not boast—were seen in the progress of science; an Eaton, the true teacher of Philosophy, had sent out some of the most distinguished on the roll of scientific men;' and Prof. R. said, 'that for himself and his associates, he felt it due that on this occasion the memory and labors of these two men should be held in recollection.'"—*Troy Daily Whig*, August 18th, 1851.

done useful service to their country in the construction of its various public and private works. The services of the Institute are the more note-worthy in this direction, inasmuch as, with the exception of instruction incidentally given at the U. S. Military Academy on this subject, in association with the courses on Military Engineering, there was no other institution in the country where any instruction was given in direct connection with the wants of the Civil Engineer, until within a few years past.

The Trustees of the Institute, although in their official relations invested with the guardianship of this institution, have, it need scarcely be mentioned, no personal interests to serve, beyond the consciousness of having striven to discharge faithfully the duties imposed upon them as public servants in charge of a public trust. For the Institute, although possessed of corporate powers and privileges, is, in every essential respect, a public institution; as such it is an object of public interest to all citizens, alike to those who are and to those who are not its official guardians. It is, therefore, not less the duty than it is the interest of the latter to bring this whole question of Institute Improvement before that portion of the general community who have been, and must ever be more immediately interested in the success of this institution. Citizens at large, of this and other states, are participants in its educational advantages; but it is reserved for those thus locally related, to possess that additional and higher interest, which, in a certain sense, proceeds from immediate proprietorship. Like that grand principle of opposite and equal effect which pervades all physical action, so every success worthily achieved in public estimation, in the onward march of such an institution, sends back a full equivalent of honorable recompense to projectors and founders; each is a participant in its meeds and gratulations, as each is a party interested in its legitimate triumphs.

It is not therefore as suppliants for favors to themselves, in view of their official relations to this institution, that the Trustees, or the members of the Committee that now represent them, appear before the public; on the contrary, while discharging the duties of a high and responsible trust to the Institute itself, they are constrained to believe that they are doing but simple and equal justice to the appreciative intelligence and public spirit of the citizens of Troy, by presenting this matter in its various aspects for their full and careful consideration.

HIRAM SLOCUM,
JOHN A. GRISWOLD,
JOSEPH M. WARREN,
JONATHAN EDWARDS,
THOMAS C. BRINSMADE,
JOHN B. TIBBITS,
JONATHAN E. WHIPPLE,
B. FRANKLIN GREENE.

COMMITTEE OF TRUSTEES.

CONTENTS.

IN BADEN.